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STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

COMMUNICATIONS DIVISION

A PRELIMINARY STUDY OF THE FEASIBILITY OF ALTERNATIVE METHODS OF TRANSMITTING VOICE, DATA AND TEXT BETWEEN LOCALITIES IN THE STATE OF MONTANA

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NARRATIVE

SCOPE

The primary task of this report is to assist the State of Montana in its responsibility to provide for the future communication requirements of its various government functions. Specifically, this report should assist in the definition of the most technically effective, reliable and cost efficient communication plan. The primary emphasis of this study is to define the requirements of the state communications network and to analyze alternative transmission methods for that network.

To accomplish this purpose, the following five areas will be addressed in this report:

1. Definitions of the present state network
2. Projections of future communication requirements
3. Definition of the future communications network
4. Comparison of alternative transmission methods
5. Summary of results

I. Present State Communications Network

The present state communications network consists of a transmission portion and a switching portion. The transmission portion is defined as those facilities which transport or carry circuits from one locality to another. For example, Telpak facilities carry circuits from Helena to Havre.

Transmission Portion

The transmission portion of the state network presently consists of the following circuit facilities:

WATS Lines
Telpak Lines
Direct Distance Dialing Lines (DDD)
Dedicated Leased Lines

A discussion of each line type follows.

WATS Lines are incoming or outgoing measured service long distance lines. These OUT-WATS and IN-WATS lines are purchased from Mountain Bell for either intra-state or inter-state calling areas. Intra-state lines serve the Montana calling area and inter-state lines serve outside Montana. IN-WATS lines, also designated as "800" numbers, are limited to incoming calls whereas OUT-WATS is limited to outgoing calling. The monthly charge per line is determined by the number of bands purchased and the total monthly minutes of use.

Telpak Lines are groups of circuits to selected Montana localities which are purchased from Mountain Belll. The State has selected the routing of the circuit groups to serve those locations with the greatest usage. The groups are available in sizes of 12, 24, 60 and 240 circuits. The circuits are terminated per tariff for either switched voice or dedicated service. The switched voice circuits are connected to the state switching network which allows the user to dial various state office extensions or WATS lines. The dedicated service consists of point-to-point voice and data circuits. The dedicated voice circuits are used for closed networks such as the METS teleconferencing system originated from Billings. Dedicated data circuits provide data transmission for low and high speed data networks operated by the Computer Services Department. Examples are the LENS network for law enforcement use and the proposed DECNET for networking the state computers. The high speed data lines require special transmission conditioning and termination per Mountain Bell's tariff. The Mountain Bell tariff limits the maximum voice band data rate to 9600 Baud.

Telpak service is a filed tariff with the State of Montana. The monthly fee varies, depending on the route or routes the circuit travels through, the quantity of circuits in that route and the type of termination for the circuit. Because Telpak is a tariffed service, it is subject to revision and rate increases by Mountain Bell. A 53.6% rate increase is presently pending in the State Public Service Commission and revisions are approved which limit Telpak service to only the existing locations. Exhibits 1-1 and 1-2 show the existing

Telpak routes and describe the capacity and present usage of each portion of the Telpak route.

Direct Distance Dialing (DDD) The Direct Distance Dialing network is utilized for communication with those points that are not served by Telpak or where WATS lines are not available to the user. These lines are regular business lines and are billed as such. Each toll call is individually rated and listed on a monthly bill, along with the local monthly service charge. Direct Distance Dialing is more expensive than the other circuits previously described.

Dedicated Leased Lines - Dedicated Leased Lines are point-to-point circuits leased on a monthly basis by the various government agencies. These lines are utilized for services that always communicate with the same point or points. Dedicated data lines from Helena to Missoula are an example of this type. Specialized circuits such as Land/Mobile base station control circuits also utilize dedicated leased lines from their control point to the transmitter base station. Other examples of leased lines are the Law Enforcement Telecommunications System (LETS), The Montana Educational Telecommunication System (METS) and the dedicated emergency service lines.

Switching Portion

The switching portion of the state communications network consists of the digital PBX and key systems located in the various government agencies. This equipment performs the function of switching calls between outside lines, individual extensions and PBX/key system operators. For the larger locations, a tariffed service called Centrex is utilized. Centrex provides switching for PBX trunks, key system trunks and selected individual extensions. This equipment is usually located in the telephone company's central office. Exhibit 2 shows the location, type of switch and line capacity of the switches presently in use in the state system. Due to the 1968 Federal Communications Commission deregulation of terminal equipment, a user now has a choice of purchasing such equipment or

leasing the equipment from the telephone company or other sources. The Department of Administration has recently analyzed state switching requirements and has awarded a bid to Centel Business Systems to provide Northern Telecom SL-1 PBX's for the Missoula, Helena, Bozeman and Billings state complexes. These new switches are part of a new generation of switching which are digital processor controlled and, therefore, can offer features which increase the efficiency of their users. These switches also have tandem switching capability which is important to the future network. It is anticipated that more of the present switching equipment will be replaced in the future.

II. Present State Communications Network Users

An understanding of the present state communications network users is essential to any analysis thereof. The Communications Division of the State Department of Administration has analyzed the usage of the state communications network utilizing several criteria. The results of this analysis are listed in Exhibit 3. Usage has been analyzed according to the top ten long distance users, including and excluding state universities, the top ten users of leased lines, the top ten users of the state telephone system, and finally, the total usage of all state communications network facilities, excluding the universities. This analysis was obtained by comparing the communication expenditures of the various departments for the last fiscal year. In order to appreciate communication needs of the various departments, data concerning each department, the number of field offices and a description of the field offices is included in Exhibit 4. It is noteworthy that there are 617 field offices located throughout the state. The need to communicate between these offices is obvious.

Appendix A of this report is a detailed list of the departments and locations of the field offices.

Land/Mobile communication networks are maintained by the Highway Department, State Lands Department, Fish, Wildlife & Parks Department

and the Highway Patrol. A radio communication system is essential for these users because many of their personnel are constantly on the move or are located at work sites that vary from day to day. In order to dispatch information to these personnel, a base station must be activated by its associated control station. These two stations are normally not at the same location and, therefore, require a communications link between them. This communications link can be a dedicated radio link or a leased line. For example, in order to dispatch someone in Glendive from Helena, a control link between these two locations would be required. Presently many of these base stations are controlled regionally rather than centrally from one point. In order to obtain central dispatch, additional control links would have to be developed. It is anticipated that this will be the case. Exhibit 5 shows the location of the base stations and control points for the land/mobile radio systems presently in use. Exhibit 5-5 shows the proposed highband system for the Highway Patrol. This system is being phased in with Great Falls as the initial phase.

Several departments maintain information networks. These information networks connect their main agency centers with their outlying offices. For example, the MSU Extension Service has an AGNET which is a dial up network. The headquarters are at Bozeman and the users are extension agents in each county. The Montana Educational Telecommunication System (METS) is headquartered at Eastern Montana College in Billings. They have dedicated lines and dial up lines to various learning centers throughout the state. This system enables students and teachers to communicate with each other remotely. The METS system utilizes the Telpak circuits where they are available and leases lines from the local telephone companies where Telpak is not available.

The State Library maintains an inter-library network which is microcomputer based. This network enables libraries throughout the state to located and obtain books from other libraries. The headquarters office in Helena also maintains a 4,800 BAUD data line

between Helena and Pullman, Washington. The seven largest libraries in the state lease similar data lines from their locations to Helena so they can also obtain the inter-library loan service from Pullman. Exhibit 6 shows the locations of these information networks.

The Computer Services Division maintains a complex network of data communication lines between many localities. One of the users of these lines is the Law Enforcement Network Service (LENS). This system gives on line bulletins and information requests to the participating law enforcement agencies. This system uses the Telpak circuits where available, but in other cases, it requires leased lines from the local telephone company. It is anticipated that more users will connect, especially if network access is less costly.

One of the prime users of the dedicated data lines is the university system. They use these lines to connect their computers to other state computers in order to obtain data bases and for such uses as payroll processing with the centralized computer in Helena. The present system does not lend itself to connecting all the computers on a high speed basis. The Computer Services Division is investigating a system such as DECNET to implement the interconnection of the state's computers. One advantage of dedicated lines which should be recognized is that many low speed data sets can be tied to a high speed data set at a terminal location. Thus, five or six low speed data lines will only require one physical data line for transmission to another point. Utilizing this method of data multiplexing is the most efficient way to increase the capacity of the existing system. Exhibit 7 details the existing data communication lines, data speed and terminal locations in the state.

III. Future Communication Requirements

There are many factors which can influence future communication requirements. First, a discussion of some of these factors will be presented as it applies to the State of Montana and, second, circuit growth projections will be developed based on these factors.

Growth Factors

Increased usage of the state's communication network is expected because of the following primary factors:

1. "Office of the Future" concepts
2. Increased use of data processing equipment
3. Potential inclusion of other government agencies in the state system

The Communications Division of the Department of Administration surveyed the state's departments to determine their future communication plans. This survey confirms that the trend is to implement the "Office of the Future" plans and an increase in data processing capabilities. The term "Office of the Future" refers to the integration of all office operations with a data processing system. For example, a local word processing system would be used to prepare correspondence and the correspondence would be stored in a centralized computer. The transmission of this correspondence would be by data lines to other similarly equipped word processing locations. The function of transmitting correspondence via data lines is referred to as "Electronic Mail". The example described is a simplified form of this. Also integrated into the future office is the facsimile machines for transmitting text and pictures from hard copies and the development of a work station concept. A work station is a CRT terminal and a telephone integrated into one unit. The employee using this work station would have access to common data bases involved with his work and would also be able to communicate with other work stations by voice or data. For instance, messages, text or diagrams could be transmitted to selected work stations throughout the state. The equivalent of copy machines would also be integrated into the automated office. Until recently, the "Office of the Future" was a concept but several companies now offer such integrated systems and although there is not yet a common interface standard, the trend is toward the integrated office concept. Increased productivity and management control are the primary reasons for this trend.

The trend in data processing is toward distributed data processing with data links to the central processor. To the State of Montana, this would mean that an increased number of small computers would be linked with data lines to the centralized processing facility at Helena. For example, Drivers License Bureaus and County Revenue Departments could process some of their data locally and then update master files maintained at the Helena main computer center. Another example would be the potential use of data collection cash registers for all of the state's liquor stores. These cash registers could be queried by a central computer and the results would be instantly available for management decisions, such as inventory control. A current example of distributed processing is the preparation of payroll on the university's computer and then the transmittal of that data to Helena via high speed data lines.

Because of these concepts, there is an increased requirement for data lines projected. Exhibit 8 shows the Computer Services Division future data communication lines.

An additional growth factor to be considered is the potential of other government agencies desiring to use the state communications network. The municipal and county governments, school districts and other political subdivisions realize that their communication requirements are also increasing along with the associated costs of such services. Therefore, they should be interested in utilizing the state communications network if they can reduce their costs. An important part of the future state network would be provisioning for cost accounting to all users. It is also possible that some federal agencies would find it cost effective to utilize the state network.

Circuit Growth Projection

Projections for future circuit quantity growth were developed, based primarily on past growth history and results of the aforementioned survey. Exhibit 9 tabulates historical circuit quantity data from 1963 to the present year of 1982. This data was analyzed,

using the least squares method of future projections and was graphed. This method gives more weight to recent years' trends than to earlier years in the study. Because calling efficiency increases with trunk size, the call handling capacity of the trunks was projected rather than the trunk quantity. Capacity is measured in CCS units (hundred call seconds). The increase in calling efficiency is explained by the Erlang traffic theory that doubling the trunk quantity more than doubles the traffic handling capacity. For small trunk quantities, the factor can be three times the traffic handling capacity. The basic theory is that the more path choices there are, the higher the probability of obtaining a free path. Exhibits 10-1 through 10-8 are graphs of the historical circuit growth and projections of future circuit growth for individual trunk groups listed in Exhibit 9. Exhibits 9 and 10 represent data only for the state communications network lines that are switched and do not represent state dedicated voice and data lines. Future dedicated lines were projected, utilizing the results of the department communication surveys conducted by the Communications Division. Exhibit 8 is an example of the survey data. Exhibit 11 is a tabulation of present dedicated line users and projected line users, such as represented by the Land/Mobile Radio System Control circuit requirements. It is projected that a user, such as the Department of Revenue, will have data lines to almost all counties by 1987. It must be remembered when projecting data lines that, as previously mentioned, several low speed modems can be multiplexed onto a high speed modem, thereby increasing the efficiency of the data lines. It is therefore anticipated that much of the increased demands for data services can be met by first increasing the speed of the data lines before additional lines need be added. The present Telpak circuits are limited to 9600 Baud whereas a digital transmission system is capable of 56K Baud. Projections of future dedicated voice and data lines were made from the Exhibit 11, 1987 base quantities. It was desirable to have distributed growth for the dedicated lines so each site was projected at the same rate as the switched circuit growth. This usually provided an increase of one circuit per site per five-year interval. This growth is believed to be quite conservative. Exhibits 12-1, 12-2 and 12-3 tabulate the circuit requirements for

1987, 1992 and 1997 respectively. The quantities shown on these exhibits represent circuits that will be terminated at each location for use by that location. This quantity is not necessarily the same as the quantity of circuit channelized in an actual transmission plan. This is because some locations perform additional functions such as regional switching centers. Also as a practical matter, circuits sometimes are channelized at junction points in order to group the circuits to specific locations, thus increasing the efficiency of the transmission system. Utilizing the circuit quantities in Exhibit 12, trunking plans were developed for specific transmission routes.

IV. Proposed State Communications System Network

Selection of Termination Points

The first task in developing a proposed communications network is to determine the localities that will be served by the network. The Communications Division of the State Department of Administration has analyzed each communication user and each locality for its communication requirements. They have developed a decision matrix which allows points for each factor considered to be important to the selection of a communication system termination locality. Exhibit 13 presents this decision matrix and tabulates the total points for all the major population centers. A minimum of five points is required to be on the state network, unless the network is routed close to a locality. Some potential sites with five points were considered too remote for the initial state network. As a matter of additional explanation, state agencies were ranked as either major users of communications or as minor users of communications. The tabulation of state agencies in Exhibit 13 only considers major communications users. Exhibit 14 tabulates the quantity of state offices per location, regardless of their status as a major or minor communication user. The selection of potential communication sites is difficult at best and the decision matrix allows a logical analysis and can be documented for all concerned parties to see. This site selection list is not presented as a final definite list, but is presented for consideration of its

merits. The sites thus selected will be used for termination points for each transmission plan to be studied.

Proposed Communications Network Configuration and Features

This section describes the physical configuration of the proposed network and its optional features. Exhibit 15 shows each selected terminal location site and its regional switching area. You will note that there are six such regional switching areas. An explanation of the regional switching area concept follows.

Regional switching areas are proposed primerily because of transmission efficiency gains and network reliability advantages. When calls can be switched within their area, transmission facilities from that area to other areas can be sized smaller. For example, in the Glendive regional area, a call from Wolf Point to Sidney would not have to pass all the way through the system back to Helena, but would only require transmission facilities from Wolf Point to Sidney and the regional center at Glendive. This would be valid for calls between any point located within the same regional switching center. The regional switching centers are set up to serve an area of common local calling interests. Only calls between regions will utilize transmission facilities between these regions. The alternative to the regional switching center would be a network whereby all terminal localities would be linked to the center in Helena. This method would require greatly increased trunk quantities.

A second advantage to the regional switching center is that a transmission failure outside of the regional center would not affect calling between localities in that center. For example, a failure in the Missoula-Helena transmission facility would not prevent calling between Kalispell, Polson, Hamilton or Missoula. Because dedicated lines are not switched, the regional switching center concept does not apply to them, except that it is proposed that all dedicated circuits will terminate at a regional switching center for purposes of cross-connecting smaller transmission facilities

and for regional maintenance advantages. From a hardware standpoint, the regional switching centers consist of a processor controlled digital switch which performs three primary functions. The first function is the PBX function. This function would process local calling between extensions, distributed smaller key systems and PBX's. All of the enhanced calling features would be available; such as call waiting, speed calling, call, queuing and camp-on, just to name a few. A second function of a regional switch would be to provide for tandem switching of calls from other regions to localities within the region. Besides inter-region calls, the regional switch would have the capability of least cost routing, which means a user simply dials the desired number and the switch determines the route that has the least cost. This capability is possible because of the processor controlled nature of the switch. The switch would also handle calls from and to the local telephone exchange and the linking of Wats lines to selected users. One feature of considerable importance is the queuing feature. This feature allows for a programmed delay in call connection when the least cost route is busy. When this route is available, the call will proceed. If after a certain delay the least cost route is not available, the call will proceed via an alternative route such as Wats or DDD network. Primary and alternate route selection would all be programmed into the switch initially and could be changed as conditions change. The third function of the regional switch is to provide SMDR functions. SMDR functions are defined as Station Message Detail Recording. This is basically a record of all calling activity which can be accounted for in terms of costs to the individual users. This feature would allow other governments and agencies to use the state network and receive a monthly bill detailing such usage. The new Dillon switch and PBX's planned for Helena, Bozeman, Missoula and Billings have the capabilities discussed.

The operation of the regional switching center can be summarized by stating that it interconnects the Local Area Network (LAN) to the local users of that network and to the other regional centers.

Exhibit 16, which is titled "Network Operation Diagram" shows a typical function of the regional center's operation. A telephone in Great Falls is connected through the network to a telephone from the Havre local state switch. Also a non-switched line providing a data link between Great Falls and Havre is shown. The primary difference between switched and non-switched lines is that non-switched lines enter the transmission system directly whereas switched lines always enter and/or exit through a switch such as a PBX, key system or Centrex.

Proposed Communications Network Technical Standards

The design of the proposed communications network, specifically the alternative transmission systems, was based on the quality standards applicable to the particular system. The present communications network meets Bell system transmission standards. The proposed network would also meet equivalent standards. Specifically the standards referred to are for channel noise performance, frequency response, cross talk, signaling quality, frequency stability and interface levels.

V. Comparison of Alternative Methods of Transmission

The comparison of selected transmission systems will allow a perspective of comparable costs and features; therefore, any future work on a state network can be more selective in its efforts. This study has analyzed microwave, fiber optics and satellite transmission systems. A discussion of each transmission method follows.

Microwave

Of the three technologies studied, microwave transmission is the oldest, best established and understood. The design, operation and reliability of such systems are well documented. As the technological advances have been made in the electronics industry; the quality, reliability and performance of microwave has steadily improved. Currently, one of the major trends is the application of digital technology to the transmission of the microwave signal.

All microwave systems were analog until the recent digital advances. There are three prime advantages offered by the new digital systems. The first is that more and more telephone equipment is becoming digital and the switching function is being performed digitally. There are thus potential cost savings when a digital transmission system is interfaced with a digital switching system. The interface standards have been developed. The second factor is that the cost of digital electronics has been dropping rapidly, making digital transmission facilities less expensive. One of the reasons for the lower cost is that handling bits is simpler than handling an analog signal and digital devices can be combined with other digital devices to a larger scale; therefore, production costs are lower. The third factor is that digital signals are regenerated rather than amplified like analog signals are. This offers an advantage because the regenerated signal is totally new and clean, whereas analog signals , when amplified, also amplify associated noise. As a practical advantage, when a digital source such as a computer utilizes a digital transmission system, the source signal does not require conversion to analog and the rather expensive modem can be eliminated and replaced with a relatively inexpensive interface unit.

One disadvantage of digital microwave has been that the smallest group of channels that could be dropped off was 24. However, companies such as Coastcom and Bayly Engineering have developed devices to drop off less than 24 channels economically. Digital microwave requires more sophisticated test equipment, but there are fewer adjustments and considerably less level setting compared to analog microwave. In general, digital RF equipment costs more than analog RF equipment, but the multiplex and channel equipment is considerably less; therefore, depending on the number of channels that are terminated, the total system cost for a digital system can be less despite higher RF costs. The proposed microwave transmission plan was priced for both a digital and an analog microwave. The cost difference can be identified specifically for the Montana system.

There are two main disadvantages of microwave in the State of Montana. First, although the electronics are quite reliable and hot standby is recommended, the atmospheric path is subject to fading. This means that under certain atmospheric conditions, the microwave signal can degrade to an unusable level. The design of the system must consider this factor in order to keep the outages to an acceptable level. An acceptable level would be considered 300 seconds per year of fading outage. The Plan II microwave design should meet these standards.

The second disadvantage is that microwave sites are usually located on high points. Quite often the high points are almost inaccessible during the extremes of Montana's weather. This means that additional transportation equipment, capable of handling mud and snow conditions, is necessary in order to perform required maintenance.

Two microwave network designs were considered in this study. Plan I is basically the plan developed for the state in 1973. Plan II was developed for this study. When the aforementioned system standards were applied to the Plan I design, it became apparent that this plan could not meet the standards. Although the sites are probably free of obstructions and should offer minimum site preparation work, the path links between sites are too long for a reliable quality signal. It would be unrealistic to replace the existing state network with a system offering less quality.

The 2 GHz band was chosen for the system design because it offered good propagation qualities and sufficient band width for the design. The analog microwave radios could be of the type offered by several manufacturers. The digital microwave radios are of a more current design. Both Farinon and Avantek offer 16 T-1 capacity radios in the 2 GHz industrial band. The design for all systems assumes hot standby operation. This offers superior link reliability and is required for the implementation of the regional switching center concept.

Exhibit 17 is a map of the Plan I proposed microwave system. Exhibit 18 is the Trunking Diagram for that Plan I system. Trunking diagrams were developed for all designs. They are required in order to determine required transmission facility capacity and to determine the quantity of circuits to be channelized. Exhibit 19 is the cost summary of the Plan I microwave system. Both analog and digital system costs have been developed. Exhibit 20 is a map of the Plan II microwave transmission system and Exhibit 21 is the Trunking Diagram for that system. Exhibit 22 is the associated cost summary for Plan II. Analog and digital microwave system costs have been also developed for Plan II. It should be remembered that Plan I does not offer the required circuit quality, and is, therefore, not comparable to any other plan.

Fiber Optics

The utilization of fiber optic technology for the transmission of communications has increased dramatically over the past three years. Many experimental applications have proven the feasibility and more recent applications have proven the cost effectiveness of this technology.

The results of considerable worldwide research and development efforts to improve signal sources and fiber quality is now apparent. These improvements are extending the economic length of systems to the point that it can be considered a viable technology for the State of Montana. There are several advantages of a fiber optics communications network. One advantage is that fibers are not sensitive to moisture and temperature as are other systems. Because the fiber is non-metallic, it can not be shorted and also is therefore immune to electrical interference. One primary advantage is the large bandwidth capability of fibers. This capability translates into large circuit capacity and high data transmission rates.

The main disadvantages of fiber optics is its difficulty to splice and installation of the cable in some areas can be very difficult. Also, although the price of light sources and fibers has dropped

at least 15% per year the last several years, the cost of repeater equipment is still quite high. The repeater equipment has to be powered from a local source because, unlike metallic transmission systems, power can not be carried with the cable. This results in the requirements for a battery supply and charging equipment, plus a local source of commercial power. Because advances in fiber optic technology are occuring so rapidly, the proposed fiber optic system design incorporates hardware which will not be available until 1983. There are many cost trade-offs in fiber optic system design. For example, by utilizing lower attenuation and/or more powerful light sources, repeater spacing is increased and, therefore, repeater quantities can be reduced. The trade-off is between the increased cost of cable and light sources compared to the cost savings obtained for the fewer repeaters required. These trade-offs were considered and are incorporated into the proposed fiber optic design.

The proposed fiber optic transmission design was based on a FST-2 system. In the digital hiarchy, this is a 6.3 MBIT system capable of 4 T-1 capacity, or 96 channels per fiber. A 20-mile spacing between repeaters was considered reasonable with long wavelength (1300 NM) multi-mode cable. Exhibits 23, 24 and 25 detail the proposed fiber optic system. Exhibit 24 is the trunking diagram and Exhibit 25 is a cost summary.

Satellite Network

The development of new satellite technology and the implementation of satellite communication systems has grown steadily since the first commercial communication satellite was put into service. Initially, only large common carriers, such as A.T. & T., could justify the cost of satellite usage. There has been a continual trend for decreasing costs. Many factors have contributed to this trend. Probably the most important factor has been advances in the satellite electronics which have increased the transmit power capabilities, signal reception and overall improvement of circuit quality. Considerable research and development efforts have resulted in very complex modulation, control and transmission techniques that

optimize the usage and capacity of the transponders. Some techniques optimize the type of transmission, such as data or voice and other modulation techniques optimize the simultaneous use of a transponder by many different users. These techniques are referred to as multiple-access. Because of the complexity of satellite transmission, a system approach is essential when considering applications. Potential vendors must be selected that can offer this approach.

It appears to be quite timely that there has been considerable development and interest in the needs of the smaller satellite system user. There are several small capacity, low cost systems available and some systems have just recently been announced. Because the primary application for the State of Montana network is voice communications, the following commercial systems were considered. The DYNAC System, the STARNET System and the SKYSWITCH System all could meet the requirements of the Montana network. These systems are optimized for the low capacity, low cost applications, such as the Montana Network. They all utilize specialized modulation and control techniques to enable many users to use a single transponder.

Costs for satellite transmission systems are composed of two parts: the ground segment and space segment. Exhibit 28 details the ground segment for the earth station hardware. The space segment cost is not an established industry figure. Usage requirements of less than a full transponder will cost considerably more per circuit than the former. Approximately $2,000 per month/percent of transponder usage is a realistic estimate. This projects $2.4 million per year for a full digital transponder. Analog transponders are less expensive to lease. When all factors are considered, a realistic estimate for transponder usage would be $700 per month per circuit. The State system would require 240 channels and would incur annual lease charges of $2,016,000. If capacity were available, the lease of a complete transponder could be considered.

Exhibits 26, 27 and 28 detail the proposed satellite system design. Exhibit 26 shows the Star Network design and Exhibit 27 shows the associated satellite system trunking diagram. The cost summary for the ground segment portion is tabulated in Exhibit 28.

Combined Technology Transmission System

The intent of the combined technology design is to optimize the application and cost advantages of each transmission technology. The design presented in Exhibit 29 is an optimized combination of all three technologies. The cost summary for the system is presented in three parts as Exhibit 30. An advantage of the combination design is that it particularly lends itself for development in phases on a regional basis.

Cost Summary - Alternative Transmission Methods

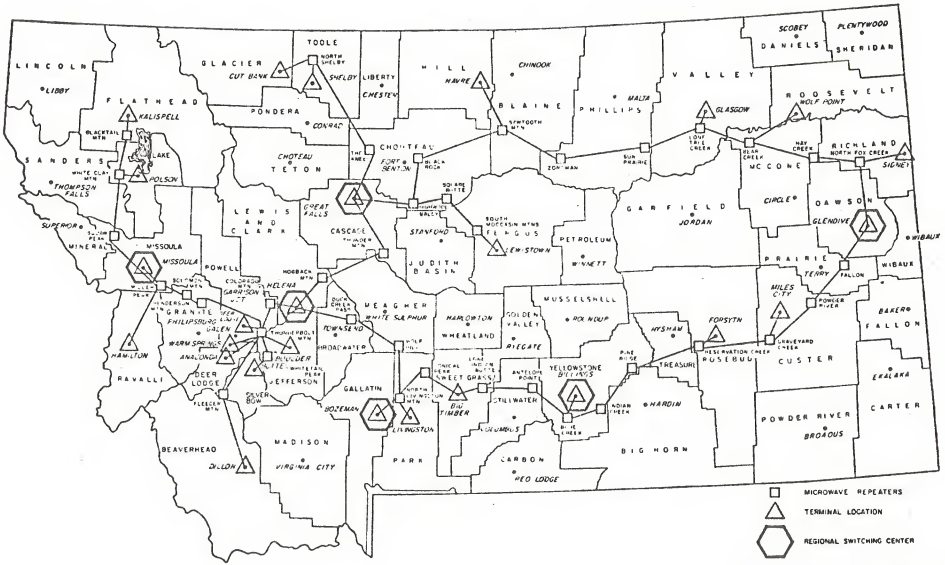
The costs of all alternative transmission systems considered are tabulated for comparison in Exhibit 31. As mentioned previously, Plan I was not considered technically compatible.

Recommendations

The State of Montana's telecommunication requirements are expected to grow considerably, primarily because of the advantages offered by improved communications between people and because of the emerging data handling environment. In order to meet these increases, a state-owned transmission system would offer several important advantages compared to the present system. First, a state network to the east and northeast regions of the state would be offered. This would increase the utility of all state users. Secondly, the state would have increased control over its communications costs and system configuration. Third, data transmission speed and quality would be improved. This feature will be of increasing importance as future data transmission needs are implemented. Fourth, the possibility of other government entities using, and therefore supporting the system, would offer increased utility to many users and cost advantages to the state.

After considering the many factors involved in an alternative transmission system, we recommend that the state requests competitive bids for a digital microwave system such as the proposed Plan II. The medium density digital microwave is recommended for maximum future capacity, particularly if video conferencing is a future possibility.

Digital microwave equipment is recommended as opposed to analog equipment because of the advantages discussed in the narrative.



STATE OF MONTANA
PROPOSED
MICROWAVE TRANSMISSION SYSTEM
PLAN II

COST SUMMARY

ALTERNATIVE TRANSMISSION METHODS

	Microwave Plant II			Fiber Optics	Satellite	Combined Methods	
		Digital					
	Analog	Low Density	Medium Density				
West	$ 3,683,200	$ 3,557,075	$ 3,826,175	$23,815,186	$9,400,500 Ground Segment +	Fiber	$ 4,055,021
East	3,851,600	3,996,175	4,347,175			Satellite - Ground Segment	6,778,000
North	4,057,400	4,552,800	4,938,900		2,016,000 Space Segment Lease	Microwave	1,313,250
Total	$11,592,200	$12,106,050	$13,112,250			Total	$12,146,271
						Satellite - Space Segment Lease	$ 2,016,000

NOTE: In addition to the above costs, estimated annual maintenance expenses of six percent of installed costs would be required.

EXHIBITS

STATE OF MONTANA

LIST OF EXHIBITS

Exhibit 1

1-1 Existing Telpak Routes

1-2 Telpak Channel Usage

Exhibit 2 Existing Telephone System Switch Information

Exhibit 3 Top Ten State Communications System Users

Exhibit 4 Departments and Field Office Description

Exhibit 5 Land/Mobile Radio System

5-1 Highway Department

5-2 State Lands Department (Forestry Div.)

5-3 Fish, Wildlife and Parks Department

5-4 Highway Patrol

5-5 Highway Patrol - Proposed Highband System

Exhibit 6 Selected Information Networks

Exhibit 7 Existing Data Communications Lines (Computer Services Division)

Exhibit 8 Future Data Communication Lines

Exhibit 9 Tie Lines and WATS Circuits, 1963-1982

Exhibit 10 Historical and Projected Growth of State Tie Lines and WATS Circuits - Graphic Illustrations

10-1 Helena Circuits

10-2 Billings and Boulder Circuits

10-3 Bozeman and Butte Circuits

10-4 Deer Lodge and Dillon Circuits

10-5 Great Falls and Havre Circuits

10-6 Kalispell Circuits

10-7 Miles City and Missoula Circuits

10-8 Warm Springs/Galen Circuits and Anaconda

Exhibit 11 Dedicated Lines - 1987

Exhibit 12 Circuit Termination Summary

12-1 1987 Quantities

12-2 1992 Quantities

12-3 1997 Quantities

Exhibit 13 Site Selection Analysis (3 pages)

Exhibit 14 Quantity of State Offices per Location (3 pages)

Exhibit 15 Regional Switching Areas

Exhibit 16 Network Operation Diagram

Exhibit 17 Proposed Microwave Transmission System, Plan I

Exhibit 18 Trunking Diagram - Microwave System, Plan I

Exhibit 19 Cost Summary - Microwave Plan I

19-1 Analog Microwave System

19-2 Digital Microwave System

Exhibit 20 Proposed Microwave Transmission, Plan II

Exhibit 21 Trunking Diagram - Microwave System, Plan II

Exhibit 22 Cost Summary - Microwave Plan II

22-1 Analog Microwave System

22-2 Digital Microwave System - Medium Density

22-3 Digital Microwave System - Low Density

Exhibit 23 Proposed Fiber Optic Transmission System

Exhibit 24 Fiber Optic Transmission System, Trunking Diagram

Exhibit 25 Fiber Optic Transmission System, Cost Summary

Exhibit 26	Proposed Satellite Transmission System - Star Network Design
Exhibit 27	Proposed Satellite Transmission System - Trunking Diagram
Exhibit 28	Cost Summary - Satellite System
Exhibit 29	Proposed Transmission System - Combined Technology
Exhibit 30	Cost Summary - Combined Technology System
Exhibit 31	Cost Summary - Alternative Transmission Methods
Appendix A	List of Departments and Locations of Field Offices

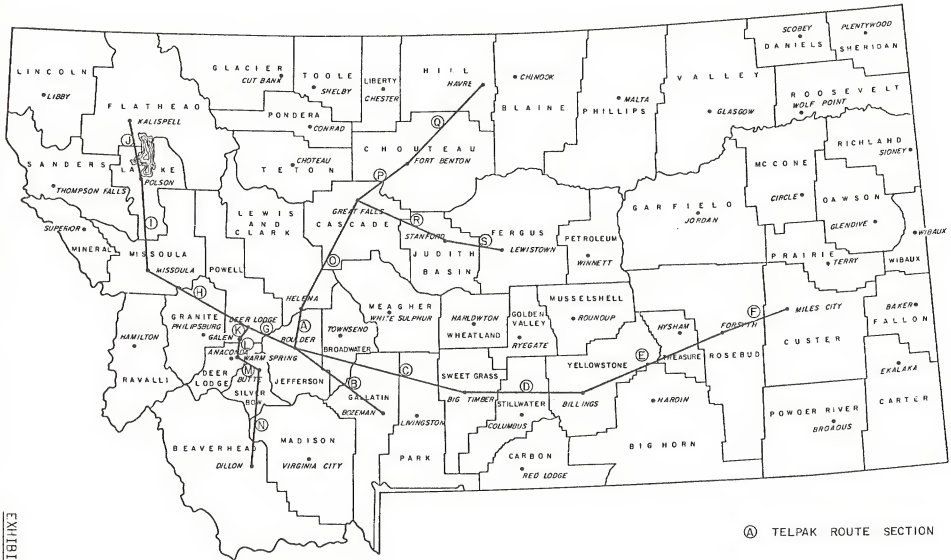


EXHIBIT I-1

STATE OF MONTANA

EXISTING TELPAK ROUTES

EXHIBIT I-1

STATE OF MONTANA

TELPAK CHANNEL USAGE

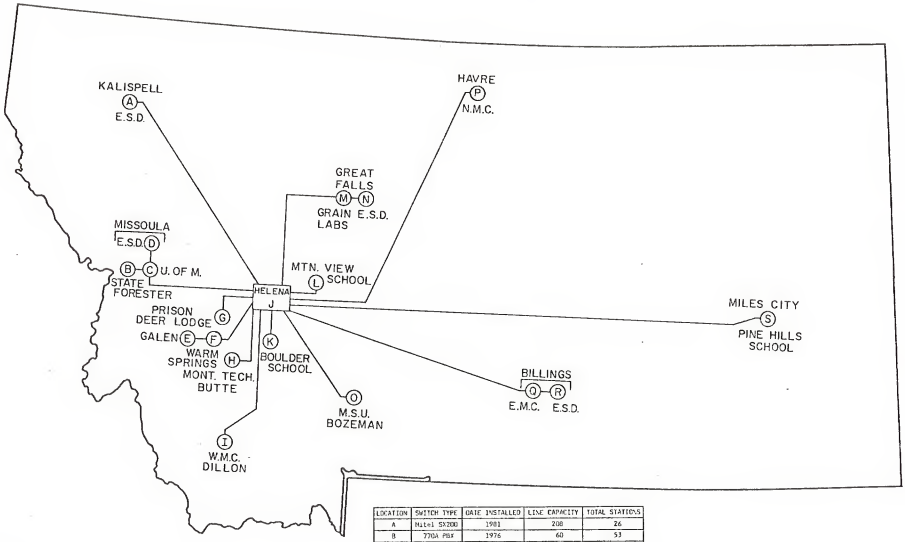
June, 1982

Air Mileage	Map Location	Line	Capacity	Network (VN)	DEDICATED Voice (VT)	DEDICATED Data VG	DEDICATED Data DG	Idle
26	A	Helena-Boulder	240	152	11	23	3	51
65	B	Boulder-Bozeman	60	26	10	8	1	15
108	C	Boulder-Big Timber	60	39	4	5	1	11
70	D	Big Timber-Billings	60	39	4	5	1	11
96	E	Billings-Forsyth	24	11	1	-	1	11
41	F	Forsyth-Miles City	24	11	1	-	1	11
32	G	Boulder-Deer Lodge	240	82	2	13	2	141
69	H	Deer Lodge-Missoula	60	43	2	6	2	7
58	I	Missoula-Polson	24	10	-	2	1	11
36	J	Polson-Kalispell	24	10	-	2	1	11
16	K	Deer Lodge-Galen	60	32	2	8	1	17
4	L	Galen-Warm Springs	60	34	2	8	1	15
19	M	Warm Springs-Butte	60	27	1	8	1	23
55	N	Butte-Dillon	12	5	1	2	1	3
72	O	Helena-Great Falls	60	29	2	4	2	23
37	P	Great Falls-Ft. Benton	12	9	1	2	1	-1
69	Q	Ft. Benton-Havre	12	9	1	2	1	-1
56	R	Great Falls-Stanford	12	-	4	2	1	5
38	S	Stanford-Lewistown	12	-	4	2	1	5

DDG = Data Data Grade
DDV = Data Voice Grade
VT = Voice Transmission
VN = Voice Network

VT = FX's, Teleconferencing
VN = State Private Line SW Network

EXHIBIT 1-2



LOCATION	SWITCH TYPE	DATE INSTALLED	LINE CAPACITY	TOTAL STATIONS
A	Hill-1 SX200	1981	208	26
B	770A PBX	1976	60	53
C	NEAX CTX	1971	3,200	2,684
D	770A PBX	1976	80	37
E	770A PBX	1977	160	109
F	770A PBX	1975	200	264
G	770A PBX	1977	120	134
H	DACO EPA	1980	300	282
I	S-C DBX1200	1982	600	408
J	NTI SL-1	1982	Trunk Sw.	
J	#5 XBAR CTX	1969	2,938	3,678
K	757 PBX	1970	160	197
L	756 PBX	1970	60	32
M	746E PBX	1968	55	56
N	770A PBX	1977	120	52
O	701 CTX	1971	2,940	2,677
P	770A PBX	1977	200	70
Q	701 CTX	1966	1,000	861
R	770A PBX	1972	80	78
S	770A PBX	1978	100	62

EXHIBIT 2

STATE OF MONTANA

EXISTING TELEPHONE SYSTEM
SWITCH INFORMATION

STATE OF MONTANA

TOP TEN STATE COMMUNICATIONS
SYSTEM USERS

LONG DISTANCE USERS (W/UNIVERSITIES)

1. Dept. of Administration
2. Montana State University
3. University of Montana
4. Fish, Wildlife and Parks
5. Eastern Montana College
6. Office of Public Instruction
7. Dept. of Labor and Industry
8. Dept. of Social & Rehabilitation Services
9. Dept. of Revenue
10. Montana Tech

LONG DISTANCE USERS (W/O UNIVERSITIES)

1. Dept. of Administration
2. Fish, Wildlife and Parks
3. Office of Public Instruction
4. Dept. of Labor and Industry
5. Dept. of Social & Rehabilitation Services
6. Dept. of Revenue
7. Dept. of Highways
8. Dept. of Commerce
9. Dept. of Justice
10. Dept. of Natural Resources & Conservation

LEASED LINE (DEDICATED) SERVICE (W/O UNIVERSITIES)

1. Dept. of Administration
2. Dept. of Justice
3. Dept. of Highways
4. Dept. of Agriculture
5. Dept. of Labor and Industry

6. Commissioner of Higher Education
7. Office of Public Instruction
8. Adjutant General
9. Dept. of Institutions
10. Dept. of Social & Rehabilitation Services

STS USAGE (W/O UNIVERSITIES)

1. Dept. of Social & Rehabilitation Services
2. Dept. of Highways
3. Dept. of Labor and Industry
4. Dept. of Revenue
5. Dept. of Fish, Wildlife and Parks
6. Health and Environmental Sciences
7. Dept. of Natural Resources and Conservation
8. Dept. of Institutions
9. Dept. of Justice
10. Dept. of Administration

TOTAL USAGE (LEASED LINES, LONG DISTANCE, DATA LINES AND STS) - W/O UNIVERSITIES

1. Dept. of Administration
2. Dept. of Justice
3. Dept. of Social & Rehabilitation Services
4. Dept. of Labor and Industry
5. Dept. of Highways
6. Dept. of Fish, Wildlife and Parks
7. Dept. of Revenue
8. Dept. of Natural Resources and Conversation
9. Dept. of Commerce
10. Dept. of Institutions

STATE OF MONTANA

DEPARTMENTS AND FIELD OFFICE DESCRIPTION

Department	Number of Field Offices	Field Offices - Description
Administration	-	
Agriculture	24	12 Specialized 12 Ag. Experiment Stations
Auditor	-	
Commerce	1	1 Bd. of Pharmacists-G. Falls
Education	2	2 School for Deaf & Blind-G. Falls Mt. Historical Soc.-Libby
Fish, Wildlife & Parks	70	5 Offices 48 Game Warden Offices 17 Game Ranges, Fish Hatcheries, etc.
Governor's Office	1	1 Legal Jurisdiction Proj.-Missoula
Health	6	6 Offices
Highways	127	11 Division Offices 92 Maintenance Shops/Garages 21 Weigh Stations 3 Miscellaneous
Institutions	64	35 Mental Health Centers 17 Community Corrections Bureaus 9 Facilities 3 Miscellaneous
Justice	19	7 Highway Patrol Offices 4 Board of Crime Control 4 Fire Marshall Bureaus 4 Miscellaneous
Labor & Industry	25	24 Job Service Offices 1 Miscellaneous
State Lands	14	12 Forestry Division Offices 2 Miscellaneous

Department	Number of Field Offices	Field Offices - Description
Livestock	30	16 Brand Inspection Offices 8 District Vets 4 Milk & Egg Bureau 1 Miscellaneous
Library	-	
Legislative Branch	-	
Lieutenant Governor	-	
Military Affairs	39	28 Guard Companies 5 D.E.S. Offices 6 Organizational Maintenance Shop
Natural Resources	14	4 Oil and Gas Conserv. District 7 Water Rights Bureaus 3 Miscellaneous
Revenue	141	55 County Appraiser/County Assessor 4 Child Support Enforce. Bureau 2 Income Tax Div. Offices 6 Investigations Offices 74 Liquor Stores
Office of Public Inst.	-	
Public Service Regulation	-	
Secretary of State	-	
Social & Rehab. Svcs.	21	21 Offices
Supreme Court	-	
University System	8	6 Colleges/Universities 2 Other
Miscellaneous	12	
TOTAL	617	

EXHIBIT 5-1

EXHIBIT 5-1

STATE OF MONTANA
LAND/MOBILE RADIO SYSTEM

HIGHWAY DEPARTMENT

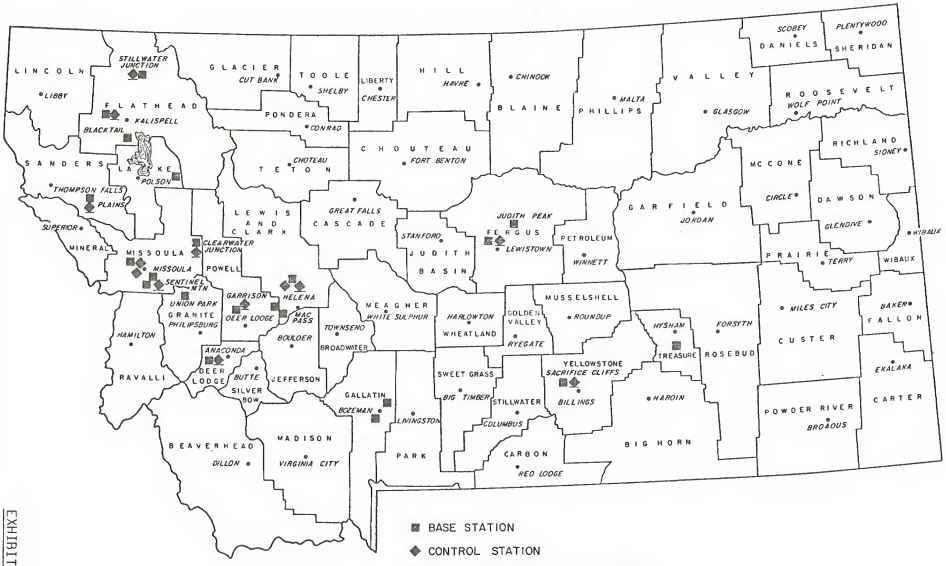


EXHIBIT 5-2

EXHIBIT 5-2

STATE OF MONTANA
LAND / MOBILE RADIO SYSTEM
STATE LANDS DEPT.
(FORESTRY DIV.)

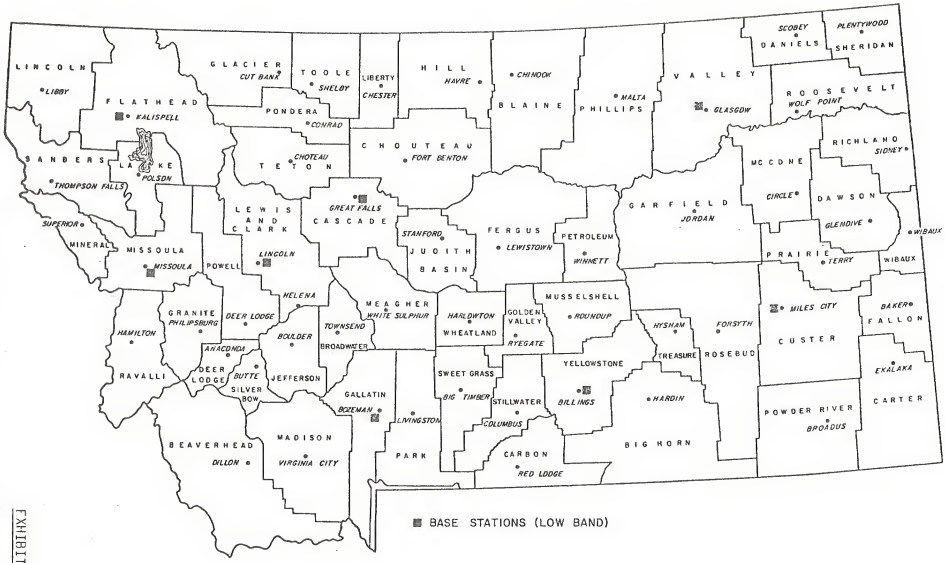


EXHIBIT 5-3

EXHIBIT 5-3

STATE OF MONTANA
LAND / MOBILE RADIO SYSTEM
FISH, WILDLIFE & PARKS
DEPARTMENT

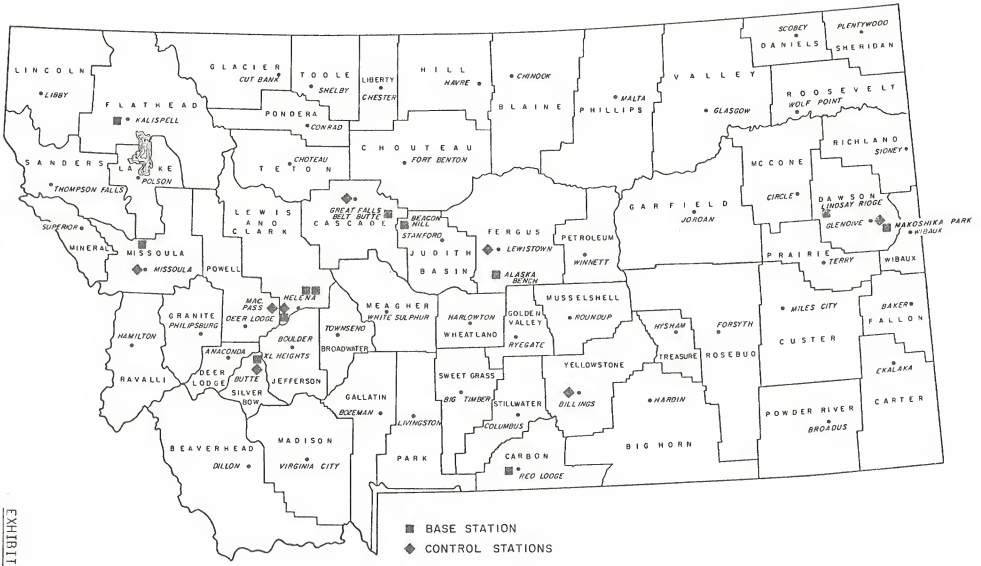


EXHIBIT 5-4

EXHIBIT 5-4

STATE OF MONTANA
LAND / MOBILE RADIO SYSTEM

HICHWAY PATROL

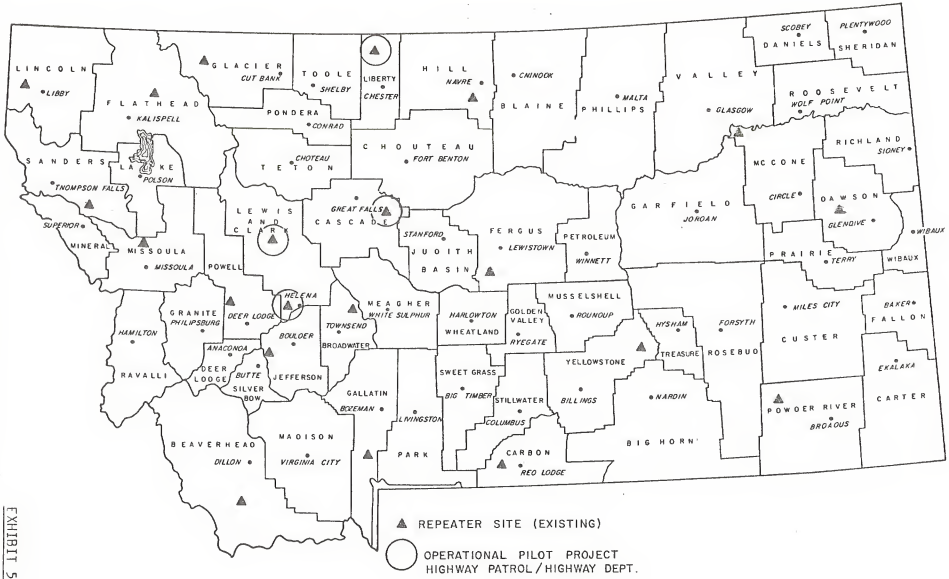


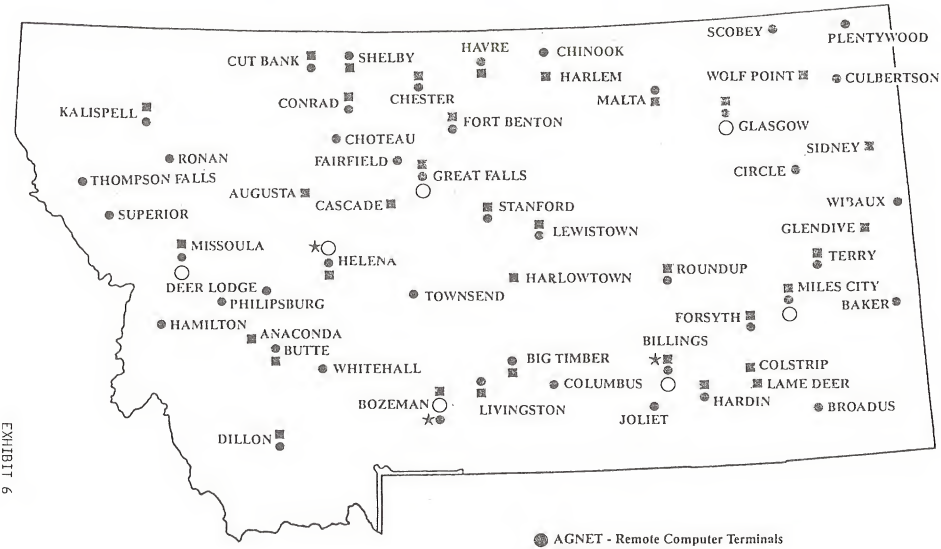
EXHIBIT 5-5

EXHIBIT 5-5

STATE OF MONTANA
PROPOSED HIGHBAND
LAND/MOBILE RADIO SYSTEM

HIGHWAY PATROL

SELECTED INFORMATION NETWORKS



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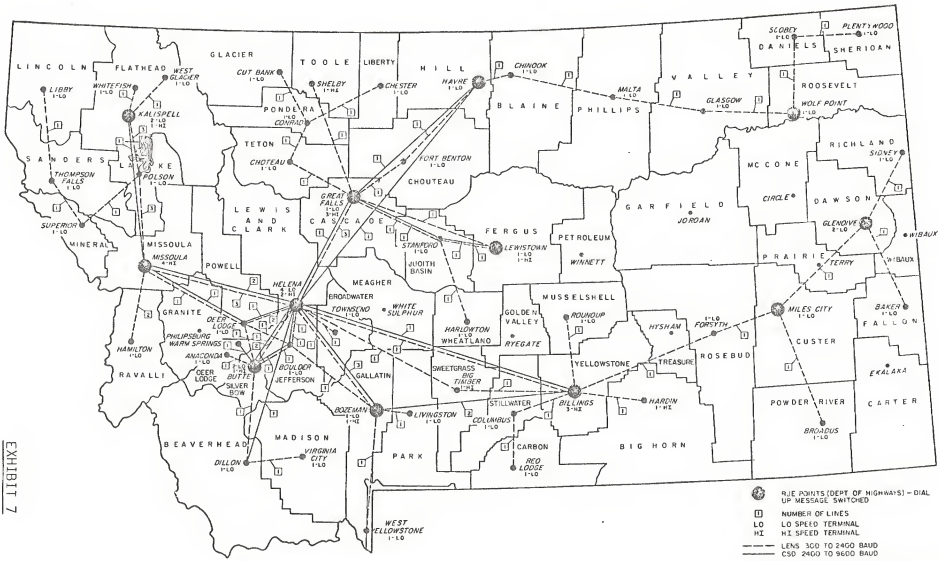
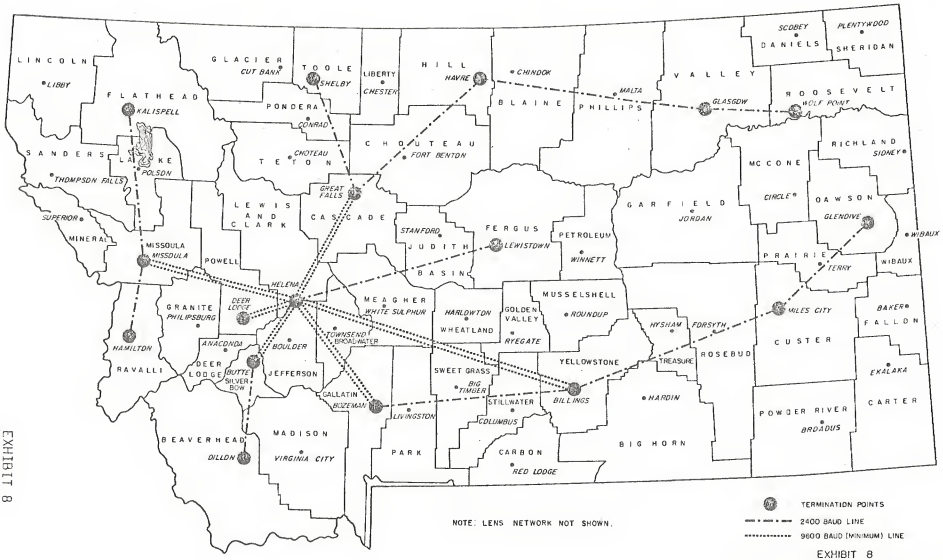


EXHIBIT 7

STATE OF MONTANA

EXISTING DATA COMMUNICATIONS LINES
(COMPUTER SERVICES DIVISION)

EXHIBIT 7



NOTE: LENS NETWORK NOT SHOWN.

EXHIBIT 8

EXHIBIT 8

STATE OF MONTANA

COMPUTER SERVICES DIVISION
FUTURE DATA COMMUNICATION LINES

TIE LINES AND WATS CIRCUITS

Helena To:	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Billings	3	3	4	4	5	6	8	8	10	12	14	18	18	21	21	21	25	28	28	28
Boulder							1	1	2	3	3	3	4	6	6	6	5	5	5	5
Bozeman	3	3	4	5	6	7	9	9	12	12	12	16	17	18	18	18	20	26	26	26
Butte		2	3	3	3	3	4	5	7	10	10	11	11	12	12	12	12	17	19	19
Deer Lodge							2	2	3	3	3	3	4	5	5	5	5	7	7	7
Dillon															3	3	3	4	5	5
Great Falls	3	3	4	4	5	6	8	8	8	10	11	12	14	16	14	14	14	19	20	20
Havre										3	3	4	4	6	6	6	6	8	9	9
Kalispell									3	3	4	5	5	7	7	7	8	10	10	10
Miles City						2	2	3	4	4	6	6	6	7	7	7	10	10	11	11
Missoula	3	3	4	5	6	7	9	9	9	12	17	22	22	24	24	24	30	33	33	33
Warm Springs (Anaconda)							3	3	3	5	6	7	7	7	7	7	7	7	8	8
Warm Springs to Galen							1	1	1	1	1	1	1	2	2	2	2	2	2	2
Total Tie Lines	12	14	19	21	25	31	47	49	62	78	90	108	113	131	132	132	147	176	183	183
WATS Lines	3	6	9	11	12	13	15	15	18	20	20	19	20	25	27	27	28	34	35	35
Total STS Circuits	15	20	28	32	37	44	62	64	80	98	110	127	133	156	159	159	175	210	218	218

EXHIBIT 9

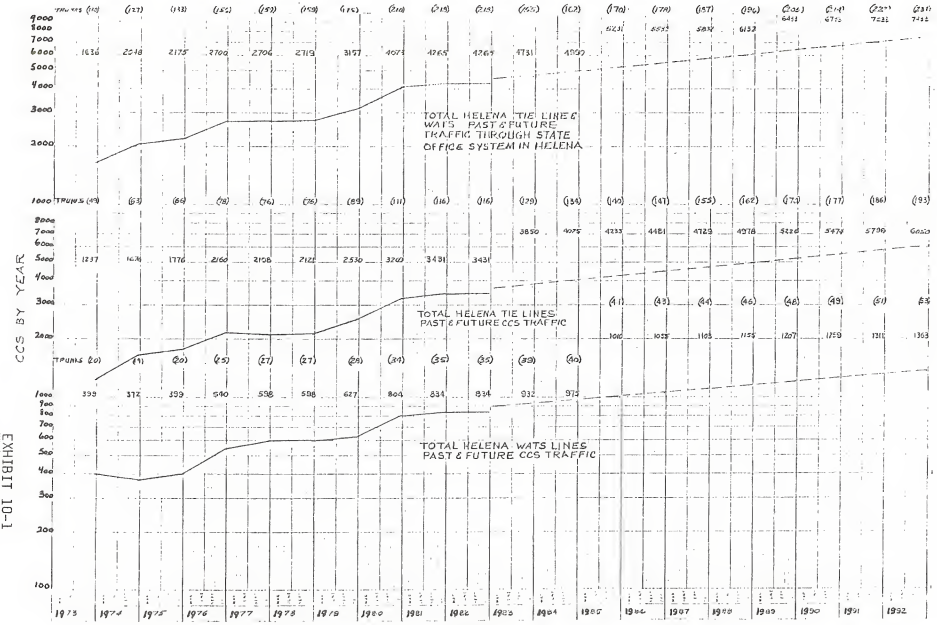

TOTAL HELENA TIE LINE & WATS PAST & FUTURE TRAFFIC THROUGH STATE OFFICE SYSTEM IN HELENA
TOTAL HELENA TIE LINES PAST & FUTURE CCS TRAFFIC
TOTAL HELENA WATS LINES PAST & FUTURE CCS TRAFFIC
CCS BY YEAR
YEARS
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992

EXHIBIT 10-1

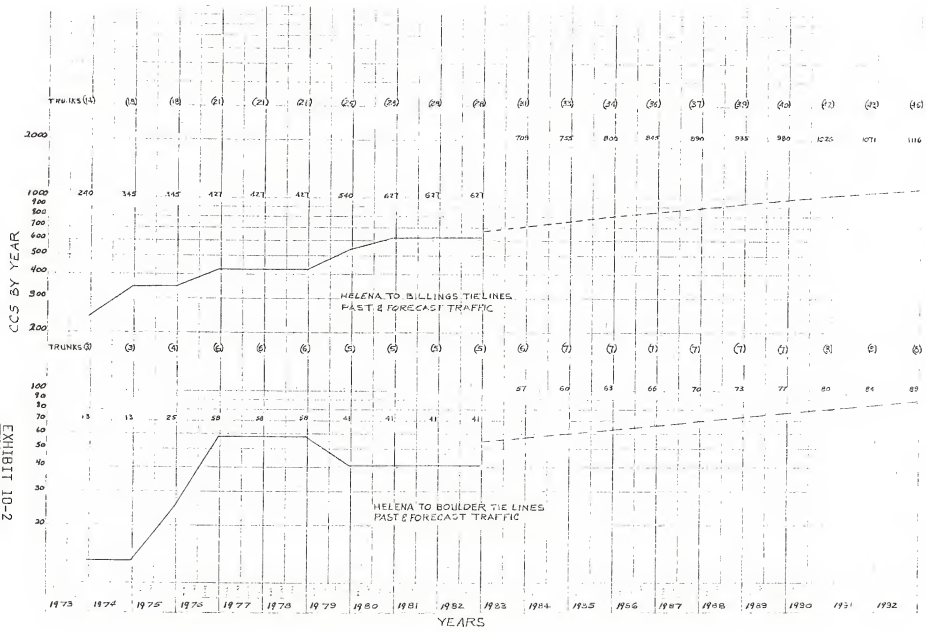
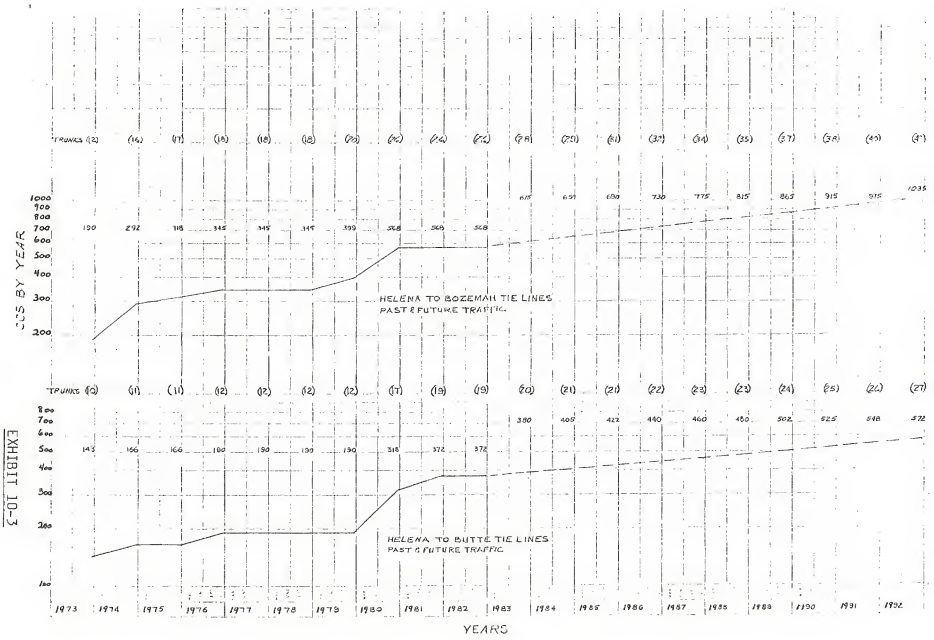

TRUNKS (4)
(8) (18) (21) (21) (21) (27) (35) (24) (28) (31) (33) (34) (36) (37) (39) (42) (42) (43) (46)
2000
1000
900
800
700
600
500
400
300
200
240 345 345 427 427 427 540 627 627 627
709 755 805 849 890 935 980 1025 1071 1116
CCS BY YEAR
HELENA TO BILLINGS TIE LINES
PAST & FORECAST TRAFFIC
TRUNKS (3)
(3) (6) (6) (6) (6) (6) (6) (5) (5) (6) (7) (7) (7) (7) (7) (7) (8) (8) (8)
100
90
80
70
60
50
40
30
20
13 13 25 38 38 38 41 41 41 41 57 60 63 66 70 73 77 80 84 89
HELENA TO BOULDER TIE LINES
PAST & FORECAST TRAFFIC
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

EXHIBIT 10-2

EXHIBIT 10-2


TRUNKS (13) (14) (17) (18) (16) (18) (20) (22) (24) (22) (23) (21) (31) (34) (35) (37) (38) (40) (41)
1000
900
800
700
600
500
400
300
200
130 292 318 345 345 349 359 368 369 368 615 654 690 730 775 815 865 915 915 1035
CCS BY YEAR
HELENA TO BOZEMAN TIE LINES
PAST & FUTURE TRAFFIC
TRUNKS (9) (11) (11) (12) (12) (12) (12) (17) (19) (19) (20) (21) (21) (22) (23) (23) (24) (25) (26) (27)
800
700
600
500
400
300
200
100
143 156 166 180 180 180 180 318 372 372 380 409 422 440 460 450 502 625 648 672
HELENA TO BUTTE TIE LINES
PAST & FUTURE TRAFFIC
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

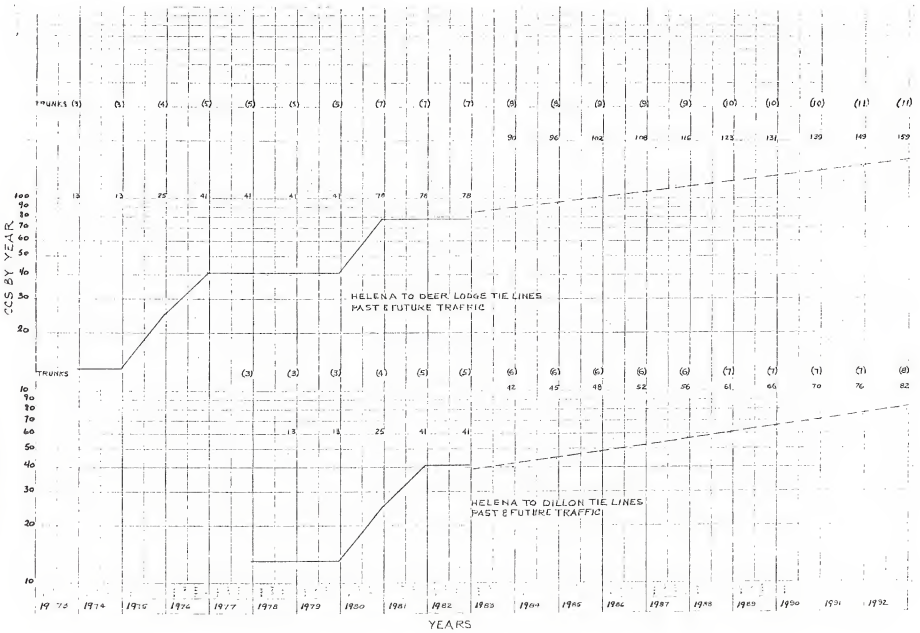
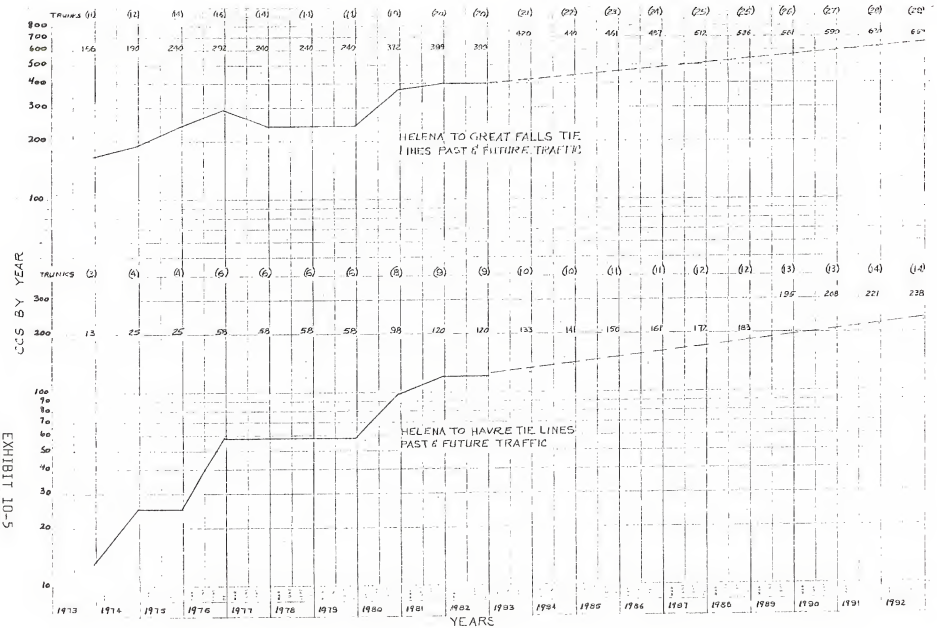

TRUNKS (3) (3) (4) (7) (5) (5) (5) (7) (7) (7) (8) (8) (9) (8) (9) (10) (10) (10) (11) (11)
90 96 102 108 115 123 131 139 149 159
12 13 25 41 41 41 41 78 78 78
CCS BY YEAR
100 90 80 70 60 50 40 30 20
HELENA TO DEER LODGE TIE LINES
PAST & FUTURE TRAFFIC
TRUNKS (3) (2) (3) (4) (5) (5) (6) (6) (6) (6) (6) (7) (7) (7) (7) (8)
42 45 48 52 56 61 66 70 76 82
13 13 25 41 41
10 90 80 70 60 50 40 30 20
HELENA TO DILLON TIE LINES
PAST & FUTURE TRAFFIC
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

EXHIBIT 10-4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800
700
600
500
400
300
200
100
156 198 240 282 240 240 240 312 389 389 420 449 461 457 512 536 561 599 634 667
HELENA TO GREAT FALLS TIE LINES PAST & FUTURE TRAFFIC
CCS BY YEAR
TRUNKS (2) (4) (1) (6) (6) (6) (6) (8) (8) (9) (10) (10) (11) (11) (12) (12) (13) (13) (14) (14)
300
200
100
90
80
70
60
50
40
30
20
10
13 25 25 58 58 58 58 98 120 120 133 141 150 161 172 185 196 208 221 238
HELENA TO HAVRE TIE LINES PAST & FUTURE TRAFFIC
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

EXHIBIT 10-5

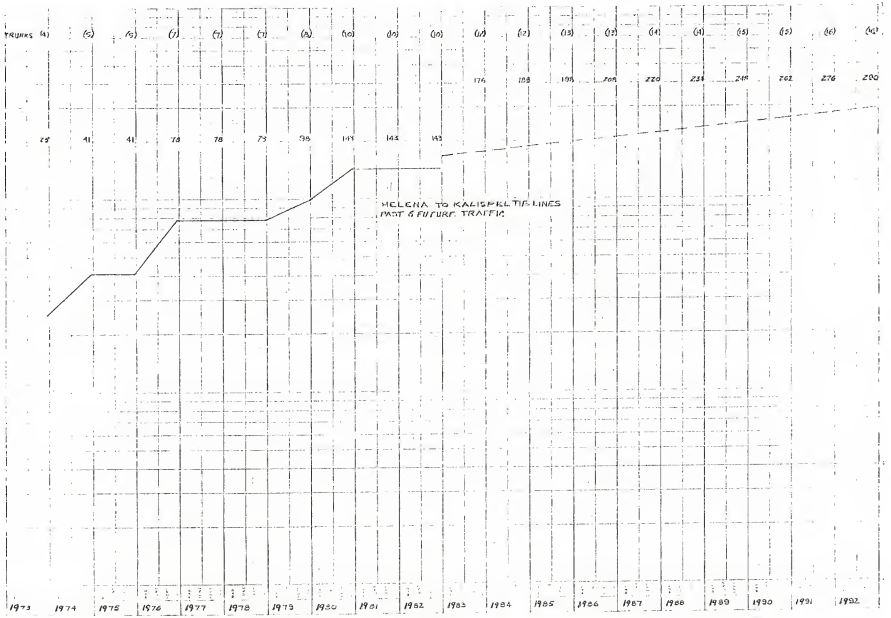

TRUNKS (4) (5) (6) (7) (7) (7) (8) (10) (10) (10) (11) (12) (13) (13) (14) (14) (15) (12) (16) (14)
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
CCS BY YEAR
25 41 41 78 78 73 96 143 143 143 176 188 196 205 220 231 249 262 276 290
HELENA TO KALISPELL TIE-LINES
PAST & FUTURE TRAFFIC
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

EXHIBIT 10-6

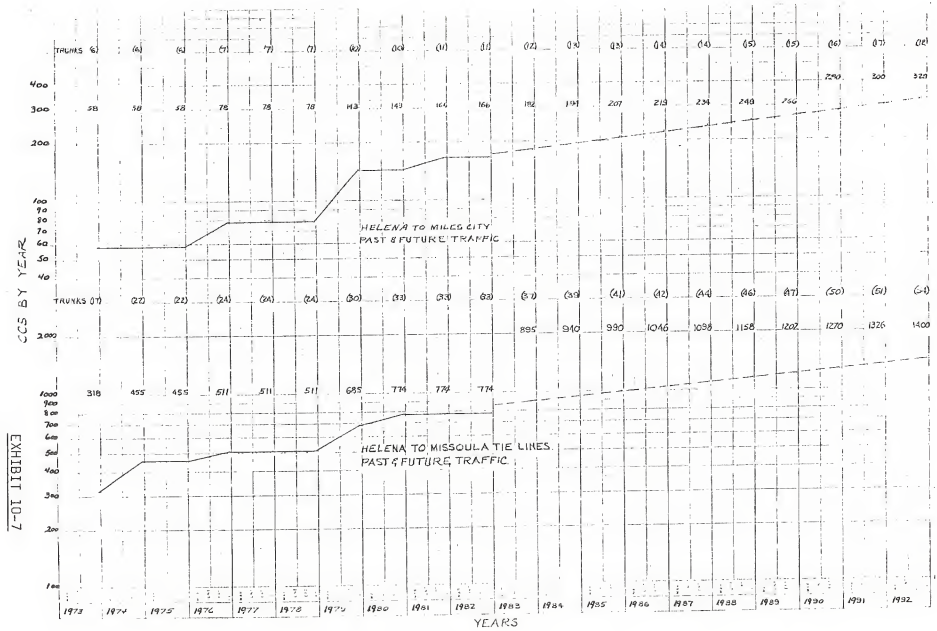

TRUNKS (6) (4) (5) (7) (7) (7) (9) (10) (11) (12) (12) (13) (14) (14) (15) (15) (16) (17) (18)
58 58 58 76 78 78 113 143 166 186 198 207 219 234 240 240 300 320
HELENA TO MILES CITY
PAST & FUTURE TRAFFIC
TRUNKS (17) (22) (22) (24) (24) (24) (30) (33) (33) (33) (31) (30) (41) (42) (44) (46) (47) (50) (51) (54)
885 940 990 1046 1098 1158 1202 1270 1326 1400
318 455 455 511 511 511 685 774 774 774
HELENA TO MISSOULA TIE LINES
PAST & FUTURE TRAFFIC
CCS BY YEAR
YEARS
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992

EXHIBIT 10-7

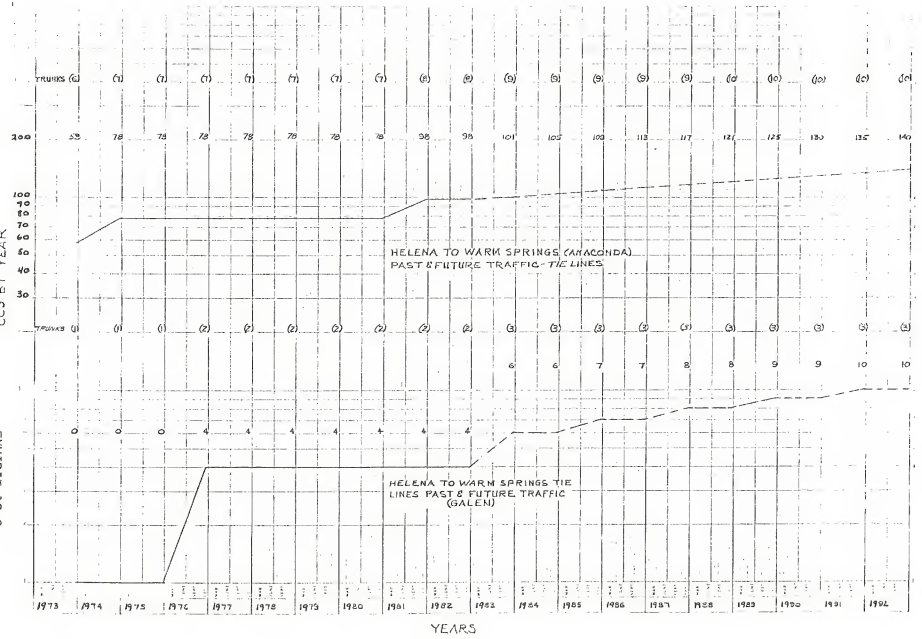

TRUNKS (c) (1) (2) (1) (1) (1) (1) (1) (2) (2) (2) (3) (3) (3) (3) (3) (3) (3) (3) (4)
200 58 78 78 78 78 78 78 78 98 98 101 105 109 113 117 121 125 130 135 140
100
90
80
70
60
50
40
30
CCS BY YEAR
TRUNKS (1) (1) (1) (2) (2) (2) (2) (2) (2) (2) (3) (3) (3) (3) (3) (3) (3) (3) (4)
6 6 7 7 8 8 9 9 10 10
0 0 0 4 4 4 4 4 4 4
HELENA TO WARM SPRINGS (ANACONDA) PAST & FUTURE TRAFFIC - TIE LINES
HELENA TO WARM SPRINGS TIE LINES PAST & FUTURE TRAFFIC (GALEN)
1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
YEARS

EXHIBIT 10-8

Location	Telpak	VOICE										DATA				Total
		L/M Control Circuits														
		H/P	Hwy.	DRNC	F&G	L/M Total	METS	Lib	DES	Publ. Radio	Total Voice	CSD	Labor & Industry	Revenue	Total Data	
Anaconda	Yes			1		1	1				2		1	1	2	4
Big Timber	Yes						1				1			1	1	2
Billings	Yes	1	1	1	1	4	20	2	1	2	29	5	2	1	8	37
Boulder	Yes													1	1	1
Bozeman	Yes		1	1	1	3	1	1		1	6	3	2	1	5	11
Butte	Yes	1	1			2	1	1			4	3	1	1	5	9
Cut Bank	No						1				1		1	1	2	3
Deer Lodge	Yes											2		1	3	3
Dillon	Yes						1	1			2	1	1	1	3	5
Forsyth	Yes			1		1	1				2			1	1	3
Glasgow	No				1	1	1				2	1	1	1	3	5
Glendive	No	2	1			3	1				4	1	1	1	3	7
Great Falls	Yes	2	1		1	4	1		1		6	6	2	1	9	15
Hamilton	No											1	1	1	3	3
Havre	Yes		1			1	1	1			3	1	1	1	3	6
Helena	Yes	9	11	4		24	1				25	13	3	1	17	42
Kalispell	Yes	1	1	4	1	7	1				8	1	2	1	4	12
Lewistown	Yes	1	1	1		3	1				4	1	1	1	3	7
Livingston	No						1				1		1	1	2	3
Miles City	Yes		1		1	2	1		1		4	1	1	1	3	7
Missoula	Yes	1	1	13	1	16	1	1	1	1	20	4	3	1	8	28
Polson	Yes												1	1	2	2
Shelby	No						1				1	1	1	1	3	4
Sidney	No						1				1		1	1	2	3
Warm Spgs/Galen	Yes													1	1	1
Wolf Point	No	1				1	1				2	1	1	1	3	5

STATE OF MONTANA

CIRCUIT TERMINATION SUMMARY

1987 QUANTITIES

EXHIBIT 12-1

	EXIST. TELPAK POINT	SWITCHED	NON-SWITCHED (DEDICATED)		TOTAL
			VOICE	DATA	
Anaconda	Yes	9	2	2	13
Big Timber	Yes	6	1	1	8
Billings	Yes	37	29	8	74
Boulder	Yes	7	-	1	8
Bozeman	Yes	34	6	5	45
Butte	Yes	22	4	5	31
Cut Bank	No	5	1	2	8
Deer Lodge	Yes	9	-	3	12
Dillon	Yes	6	2	3	11
Forsyth	Yes	7	2	1	10
Glasgow	No	14	2	3	19
Glendive	No	15	4	3	22
Great Falls	Yes	25	6	9	40
Hamilton	No	12	-	3	15
Havre	Yes	12	3	3	18
Helena	Yes	307	25	17	349
Kalispell	Yes	14	8	4	26
Lewistown	Yes	17	4	3	24
Livingston	No	10	1	2	13
Miles City	Yes	14	4	3	21
Missoula	Yes	44	20	8	72
Polson	Yes	7	-	2	9
Shelby	No	11	1	3	15
Sidney	No	11	1	2	14
Warm Spgs/Galen	Yes	3	-	1	4
Wolf Point	No	7	2	3	12

STATE OF MONTANA

CIRCUIT TERMINATION SUMMARY

1992 QUANTITIES

EXHIBIT 12-2

	EXIST. TELPAK POINT	SWITCHED	NON-SWITCHED (DEDICATED)		TOTAL
			VOICE	DATA	
Anaconda	Yes	10	3	3	16
Big Timber	Yes	7	2	2	11
Billings	Yes	45	30	9	84
Boulder	Yes	8	1	2	11
Bozeman	Yes	40	7	6	53
Butte	Yes	27	5	6	38
Cut Bank	No	6	2	3	11
Deer Lodge	Yes	11	1	4	16
Dillon	Yes	7	3	4	14
Forsyth	Yes	8	3	2	13
Glasgow	No	17	3	4	24
Glendive	No	18	5	4	27
Great Falls	Yes	29	7	10	46
Hamilton	No	14	1	4	19
Havre	Yes	14	4	4	22
Helena	Yes	324	26	22	372
Kalispell	Yes	16	9	5	30
Lewistown	Yes	20	5	4	29
Livingston	No	12	2	3	17
Miles City	Yes	17	5	4	26
Missoula	Yes	53	21	9	83
Polson	Yes	8	1	3	12
Shelby	No	13	2	4	19
Sidney	No	13	2	3	18
Warm Spgs/Galen	Yes	3	1	2	6
Wolf Point	No	8	3	4	15

STATE OF MONTANA

CIRCUIT TERMINATION SUMMARY

1997 QUANTITIES

EXHIBIT 12-3

	EXIST. TELPAK POINT	SWITCHED	NON-SWITCHED (DEDICATED)		TOTAL
			VOICE	DATA	
Anaconda	Yes	11	4	4	19
Big Timber	Yes	8	3	3	14
Billings	Yes	52	35	11	98
Boulder	Yes	9	2	3	14
Bozeman	Yes	47	8	7	62
Butte	Yes	31	6	7	44
Cut Bank	No	7	3	4	14
Deer Lodge	Yes	12	2	5	19
Dillon	Yes	9	4	5	18
Forsyth	Yes	9	4	3	16
Glasgow	No	20	4	5	29
Glendive	No	21	6	5	32
Great Falls	Yes	33	8	12	53
Hamilton	No	16	2	5	23
Havre	Yes	16	5	5	26
Helena	Yes	378	30	26	434
Kalispell	Yes	19	10	6	35
Lewistown	Yes	23	6	5	34
Livingston	No	14	3	4	21
Miles City	Yes	20	6	5	31
Missoula	Yes	62	24	11	97
Polson	Yes	9	2	4	15
Shelby	No	15	3	5	23
Sidney	No	15	3	4	22
Warm Spgs/Galen	Yes	3	2	3	8
Wolf Point	No	9	4	5	18

SITE SELECTION ANALYSIS

City	Population Rank	County Seat	Telpak	State Agencies	State Inst. or Comm. College	Lens	Lens-High Speed	Hwy. Patrol Div.	Hwy. Dept. Div.	Agriculture	Commerce	Fish, W. & Parks	Institutions	Labor	DNRC	SRS	Total Points	On System
Billings	1	X	X	22	X	X	X	X	X	X		X	X	X	X	X	14	Yes
Great Falls	2	X	X	19		X	X	X	X	X	X	X	X	X	X	X	14	Yes
Butte	3	X	X	18	X	X	X	X	X	X		X	X	X		X	13	Yes
Missoula	4	X	X	19	X	X	X	X	X	X		X	X	X	X	X	14	Yes
Helena	5	X	X	C	X	X	X	HQ	HQ	X	X	X	X	X	X	X	15	Yes
Bozeman	6	X	X	17	X	X	X	X	X	X		X	X	X	X	X	14	Yes
Anaconda	7	X	X	7		X							X	X			6	Yes
Havre	8	X	X	10	X	X			X	X		X	X	X	X	X	12	Yes
Kalispell	9	X	X	16	X	X	X	X	X	X		X	X	X	X	X	14	Yes
Miles City	10	X	X	9	X	X			X	X		X	X	X	X	X	12	Yes
Lewistown	11	X	X	12	X	X	X	X	X	X		X	X	X	X	X	14	Yes
Livingston	12	X		7		X						X	X	X		X	7	Yes
Glendive	13	X		13	X	X			X	X		X	X	X	X	X	11	Yes
Sidney	14	X		10		X				X			X	X	X		7	Yes
Laurel	15	(SEE BILLINGS)																
Glasgow	16	X		11		X				X		X	X	X	X	X	9	Yes
Deer Lodge	17	X	X	8	X	X						X	X	X		X	9	Yes
Dillon	18	X	X	8	X	X				X		X	X	X			9	Yes
Whitefish	19	X		3		X						X					4	No
Cut Bank	20	X		4		X							X	X			5	Yes
Hardin	21	X		4		X	X					X	X				5	No
Shelby	22	X		9		X	X			X		X	X	X	X	X	9	Yes
Conrad	24	X		4		X				X			X				4	No
Wolf Point	25	X		6		X			X	X			X	X		X	7	Yes
Polson	26	X	X	6		X	X			X		X	X	X			8	Yes

NOTE: Population - Top 20 Towns = 1 Point

City	Population Rank	County Seat	Telpak	State Agencies	State Inst. or Comm. College	Lens	Lens-High Speed	Hwy. Patrol Div.	Hwy. Dept. Div.	Agriculture	Commerce	Fish, W. & Parks	Institutions	Labor	DNRC	SRS	Total Points	On System
Libby	27	X		8		X						X	X	X			5	No
Hamilton	28	X		10		X	X			X		X	X	X	X		8	Yes
Forsyth	29	X	X	4		X						X	X				5	Yes
Plentywood	30	X		5		X						X	X				4	No
Malta	31	X		5		X						X	X				4	No
Baker	32	X		4		X				X		X					4	No
Roundup	34	X		6		X						X	X				4	No
Red Lodge	35	X		3		X						X	X				4	No
Choteau	36	X		4		X						X	X				4	No
Fort Benton	37	X	X	3		X						X					4	No
Big Timber	38	X	X	4		X	X					X	X				6	Yes
Chinook	39	X		6		X				X		X	X				5	No
Townsend	41	X		3		X						X					3	No
Thompson Falls	43	X		5		X						X	X	X			5	No
Boulder	44	X	X	4	X	X										X	5	Yes
Columbus	45	X		3		X						X	X				4	No
Scobey	46	X		2		X											2	No
Broadus	--	X		3		X						X					3	No
Chester	--	X		3		X							X				3	No
Stanford	--	X	X	3		X						X					4	No
Virginia City	--	X		1		X											2	No
W. Glacier	--			-		X											1	No
West Yellowstone	--			3		X						X					2	No

City	Population Rank	County Seat	Telpak	State Agencies	State Inst. or Comm. College	Lens	Lens-High Speed	Hwy. Patrol Div.	Hwy. Dept. Div.	Agriculture	Commerce	Fish, W. & Parks	Institutions	Labor	DNRC	SRS	Total Points	On System
Galen - Warm Springs	--		X	4													2	Yes
Ashland	--			5								X			X		2	No
Browning	50			5	X									X		X	3	No
Harlowtown	52	X		5	X							X	X				4	No

STATE OF MONTANA

QUANTITY OF STATE OFFICES PER LOCATION

Community	Offices	Community	Offices	Community	Offices
Alberton	1	Conrad	5	Gallatin Gateway	1
Anaconda	9	Corvallis	2	Gardiner	1
Ashland	3	Crane	1	Garrison	1
Augusta	3	Creston	1	Glasgow	14
Baker	5	Creeks Camp	1	Glendive	15
Basin	1	Crow Agency	2	Great Falls	32
Beaverslide	1	Crystal Creek	4	Grass Range	1
Belgrade	3	Culbertson	2	Greenough	1
Belt	1	Custer	1	Hamilton	12
Big Fork	1	Cut Bank	5	Hardin	6
Big Sandy	1	Deep Creek	1	Harlem	2
Big Sky	1	Deer Lodge	10	Harlowton	7
Big Timber	6	Denton	1	Harrison	2
Billings	45*	Dillon	10*	Havre	12*
Bonner	1	Divide	1	Hillside	1
Boulder	4	Drummond	3	Hobson	3
Boyes	1	Duck Creek	1	Hot Springs	1
Bozeman	25*	Dupuyer	1	Huntley	1
Broadus	4	Dutton	1	Hysham	2
Browning	4	Ekalaka	1	Ingomar	1
Busby	1	Ennis	5	Jordan	2
Butte	23*	Eureka	2	Kalispell	22
Cascade	2	Fairfield	2	Lame Deer	1
Chester	4	Fiddleback	1	Laurel	1
Chinook	8	Flowing Wells	1	Lewistown	17
Choteau	5	Forsyth	7	Libby	13
Circle	4	Fort Benton	4	Lima	2
Colstrip	2	Frenchtown	2	Lincoln	3
Columbia Falls	4	Fromberg	1	Livingston	10
Columbus	4	Galen	1	Lodge Grass	1

* University Counted as One

Community	Offices	Community	Offices	Community	Offices
Lolo	1	Roundup	5	Thompson Falls	6
Malta	6	Roy	1	Three Forks	2
Miles City	15	Ryegate	2	Townsend	5
Missoula	34*	Saint Ignatius	1	Troy	2
Mobridge	1	Saint Mary	1	Twin Bridges	1
Moccasin	1	Saltese	1	Victor	1
Noxon	1	Scobey	3	Virginia City	1
Nyack	1	Seeley Lake	1	Walkerville	1
Opheim	1	Shelby	11	Warm Springs	3
Ovando	1	Sheridan	2	W. Yellowstone	3
Philipsburg	3	Sidney	11	Whitefish	3
Plains	2	Stanford	3	Whitehall	4
Plentywood	6	Stevensville	1	Wh Sulfur Spgs	4
Polson	7	Summit	1	Wibaux	3
Poplar	2	Sunburst	1	Wilsall	1
Rainy Lake	1	Sun River	1	Winnett	3
Ravalli	1	Superior	4	Wisdom	1
Red Lodge	4	Swan Lake	3	Wolf Creek	1
Ronan	4	Terry	2	Wolf Point	7

* University Counted as One

STATE OF MONTANA

TOWNS WITH TEN OR MORE OFFICES

Billings	(Telpak)
Bozeman	(Telpak)
Butte	(Telpak)
Deer Lodge	(Telpak)
Dillon	(Telpak)
Glasgow	
Glendive	
Great Falls	(Telpak)
Hamilton	
Havre	(Telpak)
Helena	(Telpak)
Kalispell	(Telpak)
Lewistown	(Telpak)
Libby	
Livingston	
Miles City	(Telpak)
Missoula	(Telpak)
Shelby	
Sidney	

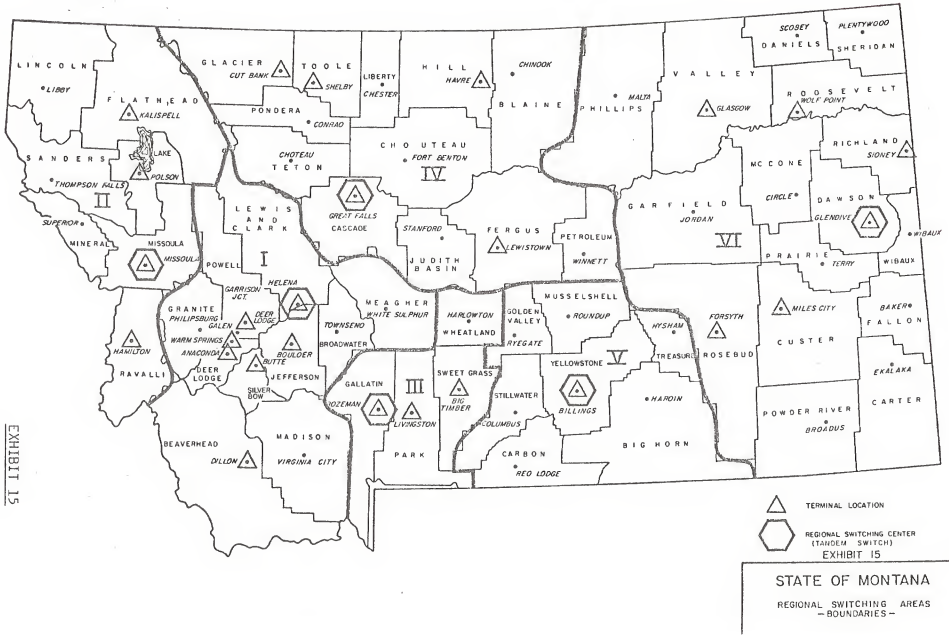
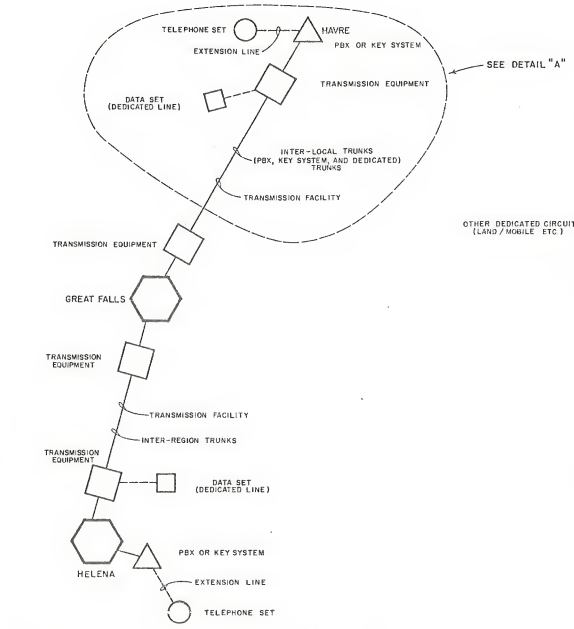


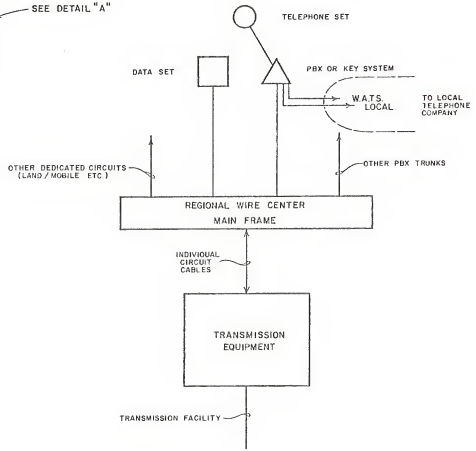
EXHIBIT 15

EXHIBIT 15

STATE OF MONTANA

REGIONAL SWITCHING AREAS
– BOUNDARIES –





DETAIL "A"

EXHIBIT 16

STATE OF MONTANA

NETWORK OPERATION DIAGRAM

EXHIBIT 16

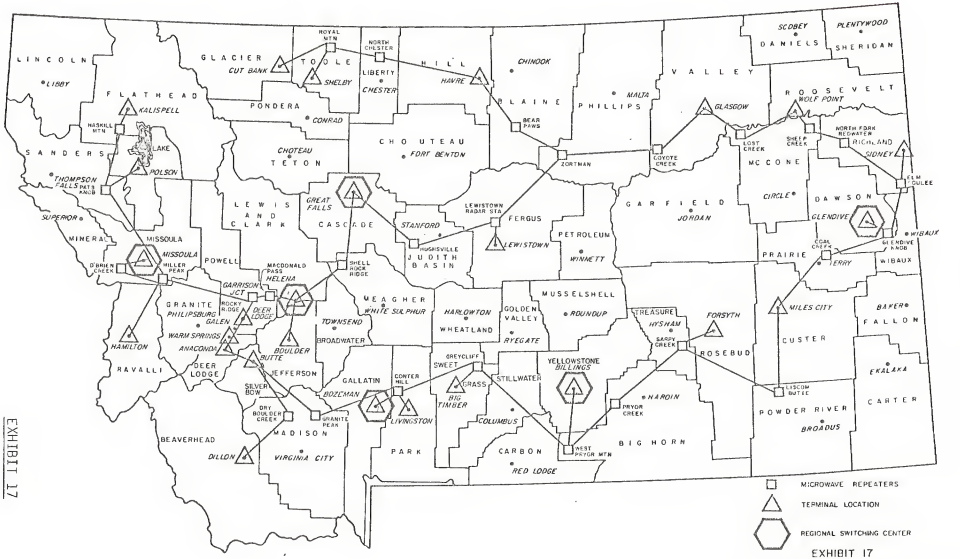


EXHIBIT 17

EXHIBIT 17

STATE OF MONTANA
PROPOSED
MICROWAVE TRANSMISSION SYSTEM
PLAN I

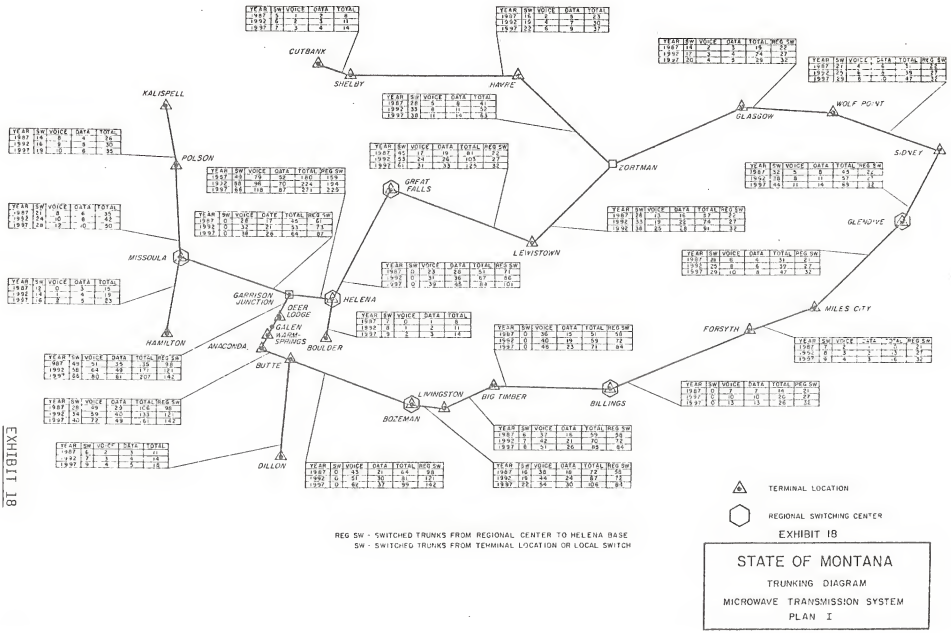

CUTBANK
SHELBY
HAVRE
KALISPELL
POLSON
GREAT FALLS
ZORTMAN
GLASGOW
WOLF POINT
SIDNEY
GLENDIVE
LEWISTOWN
MISSOULA
GARRISON JUNCTION
HELENA
DEER LODGE
GALEN AZUSA SPRINGS
BOULDER
ANACONDA
HAMILTON
BUTTE
LIVINGSTON
BOZEMAN
BIG TIMBER
BILLINGS
FORSYTH
MILES CITY
DILLON
REG SW - SWITCHED TRUNKS FROM REGIONAL CENTER TO HELENA BASE
SW - SWITCHED TRUNKS FROM TERMINAL LOCATION OR LOCAL SWITCH
TERMINAL LOCATION
REGIONAL SWITCHING CENTER
EXHIBIT 18
STATE OF MONTANA
TRUNKING DIAGRAM
MICROWAVE TRANSMISSION SYSTEM
PLAN I

EXHIBIT 18

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Analog Microwave
1997 System Quantities
Plan 1

RF Terminal Cost/Unit	$ 29900	Channel Equip/Circuit	$ 1400
DC Power Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Point	$ 10000	Antenna System Cost/Antenna	$ 4500
(DC Pwr Supply Base Cost	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bdg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
										Technical Details			Extended Costs				
Helena	1	229		4000	30	2	0	1	0	59800	9000	12000	20000	0	10000	320600	$ 431400
Boulder	1	28	29	4400	200	1	0	1	0	29900	4500	80000	17000	0	10000	39200	$ 180600
McDonald Pass	1		12	7100	30	0	0	4	1	95000	0	12000	0	0	40000	0	$ 147000
Rocky Ridge	1		19	5850	30	3	1	3	0	89700	13500	12000	23000	35000	30000	0	$ 203200
Miller Peak	1		60	7000	30	3	1	3	0	89700	13500	12000	23000	35000	30000	0	$ 203200
Hamilton	0	23	38	4100	30	1	0	1	0	29900	4500	12000	17000	0	10000	32200	$ 105600
O'Brien Creek	1		14	5000	30	0	0	1	1	95000	0	12000	0	0	10000	0	$ 117000
Missoula	1	151	6	3200	30	1	0	1	0	29900	4500	12000	17000	0	10000	211400	$ 284800
Pats Knob	1		61	6600	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Polson	1	15	42	3020	30	1	0	1	0	29900	4500	12000	17000	0	10000	21000	$ 94400
Haskill Mt.	1		50	6200	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Kalispell	1	35	16	3000	30	1	0	1	0	29900	4500	12000	17000	0	10000	49000	$ 122400
Deer Lodge	1	19	9	4600	50	2	1	2	0	59800	9000	20000	20000	35000	20000	26600	$ 190400
Anaconda	1	18	22	6000	30	2	1	2	0	59800	9000	12000	20000	35000	20000	25200	$ 181000
Butte	1	44	24	8250	30	3	1	4	0	89700	13500	12000	23000	35000	40000	61600	$ 274800
Dry Boulder Creek	1		30	8400	30	2	1	3	0	59800	9000	12000	20000	35000	30000	0	$ 165800
Dillon	1	18	36	5100	30	1	0	1	0	29900	4500	12000	17000	0	10000	25200	$ 98600
Granite Peak	1		40	9800	30	2	1	4	0	59800	9000	12000	20000	35000	40000	0	$ 175800
Conter Hill	1		44	7300	30	4	1	4	0	119600	18000	12000	26000	35000	40000	0	$ 250600
Bozeman	1	121	10	5000	30	1	0	1	0	29900	4500	12000	17000	0	10000	169400	$ 242800
Livingston	0	21	10	4500	40	1	0	1	0	29900	4500	16000	17000	0	10000	29400	$ 106800
Grey Cliff	1		56	5090	30	3	0	3	0	89700	13500	12000	23000	0	30000	0	$ 168200
Big Timber	0	14	14	3870	30	1	0	1	0	29900	4500	12000	17000	0	10000	19600	$ 93000
West Pryor Mt.	1		61	6690	30	3	1	2	0	89700	13500	12000	23000	35000	20000	0	$ 193200
Billings	1	98	32	3200	50	1	0	1	0	29900	4500	20000	17000	0	10000	137200	$ 218600
SUBTOTALS										1475700	193500	388000	451000	385000	500000	1167600	$ 4560800

Total Cost For Former Tel Pak Points $ 4255400

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bdg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
SUBTOTALS										1475700	193500	388000	451000	385000	500000	1167600	4560800
Pryor Creek	1		35	4200	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Sarpy	1		61	4800	30	3	1	2	0	89700	13500	12000	23000	35000	20000	0	$ 193200
Forsyth	1	16	32	3200	30	1	0	1	0	29900	4500	12000	17000	0	10000	22400	$ 95800
Liscom Butte	1		45	4317	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Signal Butte	1		46	2900	230	3	1	2	0	89700	13500	92000	23000	35000	20000	0	$ 273200
Miles City	1	31	6	2500	40	1	0	1	0	29900	4500	16000	17000	0	10000	43400	$ 120800
Coal Creek	0		43	2900	180	2	1	2	0	59800	9000	72000	20000	35000	20000	0	$ 215800
Glendive Knob	0		30	2600	110	3	1	2	0	89700	13500	44000	23000	35000	20000	0	$ 225200
Glendive	0	180	8	2180	190	1	0	1	0	29900	4500	76000	17000	0	10000	252000	$ 389400
Elm Coulee	0		34	2500	250	3	1	3	0	89700	13500	100000	23000	35000	30000	0	$ 291200
Sidney	0	22	20	2000	30	1	0	1	0	29900	4500	12000	17000	0	10000	30800	$ 104200
N. F. Redwater	0		39	2700	150	2	1	2	0	59800	9000	60000	20000	35000	20000	0	$ 203800
Sheep Creek	0		35	2500	150	0	0	1	1	95000	0	60000	0	0	10000	0	$ 165000
Wolf Point	0	18	12	2000	50	2	0	1	0	59800	9000	20000	20000	0	10000	25200	$ 144000
Lost Creek	0		31	2700	100	0	0	1	1	95000	0	40000	0	0	10000	0	$ 145000
Coyote Creek	0		22	2400	30	3	1	2	0	89700	13500	12000	23000	35000	20000	0	$ 193200
Glasgow	0	29	3	2090	40	1	0	1	0	29900	4500	16000	17000	0	10000	40600	$ 118000
Willow Creek	0		28	3100	60	2	1	1	0	59800	9000	24000	20000	35000	10000	0	$ 157800
Zortman	1		62	5500	30	3	1	2	0	89700	13500	12000	23000	35000	20000	0	$ 193200
Bear Paws	1		45	5900	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Havre	1	26	24	2600	100	2	1	1	0	59800	9000	40000	20000	35000	10000	36400	$ 210200
Chester	0		42	3600	80	2	1	2	0	59800	9000	32000	20000	35000	20000	0	$ 175800
Mt. Royal	0		27	6900	30	3	1	2	0	89700	13500	12000	23000	35000	20000	0	$ 193200
Cut Bank	0	14	56	3850	100	1	0	1	0	29900	4500	40000	17000	0	10000	19600	$ 121000
Shelby	0	23	31	3290	50	1	0	1	0	29900	4500	20000	17000	0	10000	32200	$ 113600
Radar Site	1		57	6400	30	3	1	1	0	89700	13500	12000	23000	35000	10000	0	$ 183200
Lewistown	1	34	5	3700	40	1	0	1	0	29900	4500	16000	17000	0	10000	47600	$ 125000
Hughesville	1		54	8600	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Great Falls	1	222	44	3600	150	2	0	1	0	59800	9000	60000	20000	0	10000	310800	$ 469600
Shell Rock Ridge	1		41	7800	30	2	1	2	0	59800	9000	12000	20000	35000	20000	0	$ 155800
Helena	1	185	29	4000	0	1	0	1	0	29900	4500	0	17000	0	10000	259000	$ 320400
TOTALS										3370000	450000	1360000	1028000	1015000	970000	2287600	$ 10480600

Total Cost For Former Tel Pak Points $ 7219000

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave
1997 System Quantities
Plan 1

RF Terminal Cost/Unit	$ 68600	Channel Equip/Circuit	$ 325
DC Power Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Point	$ 10000	Antenna System Cost/Antenna	$ 4500
(DC Pwr Supply Base Cost	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bdg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
						Technical Details				Extended Costs							
Helena	1	229		4000	30	2	0	1	0	137200	9000	12000	20000	0	10000	74425	$ 262625
Boulder	1	28	29	4400	200	1	0	1	0	68600	4500	80000	17000	0	10000	9100	$ 189200
McDonald Pass	1		12	7100	30	0	0	4	1	95000	0	12000	0	0	40000	0	$ 147000
Rocky Ridge	1		19	5850	30	3	1	3	0	205800	13500	12000	23000	35000	30000	0	$ 319300
Miller Peak	1		60	7000	30	3	1	3	0	205800	13500	12000	23000	35000	30000	0	$ 319300
Hamilton	0	23	38	4100	30	1	0	1	0	68600	4500	12000	17000	0	10000	7475	$ 119575
O'Brien Creek	1		14	5000	30	0	0	1	1	95000	0	12000	0	0	10000	0	$ 117000
Missoula	1	151	6	3200	30	1	0	1	0	68600	4500	12000	17000	0	10000	49075	$ 161175
Pats Knob	1		61	6600	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Polson	1	15	42	3020	30	1	0	1	0	68600	4500	12000	17000	0	10000	4875	$ 116975
Haskill Mt.	1		50	6200	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Kalispell	1	35	16	3000	30	1	0	1	0	68600	4500	12000	17000	0	10000	11375	$ 123475
Deer Lodge	1	19	9	4600	50	2	1	2	0	137200	9000	20000	20000	35000	20000	6175	$ 247375
Anaconda	1	18	22	6000	30	2	1	2	0	137200	9000	12000	20000	35000	20000	5850	$ 239050
Butte	1	44	24	8250	30	3	1	4	0	205800	13500	12000	23000	35000	40000	14300	$ 343600
Dry Boulder Creek	1		30	8400	30	2	1	3	0	137200	9000	12000	20000	35000	30000	0	$ 243200
Dillon	1	18	36	5100	30	1	0	1	0	68600	4500	12000	17000	0	10000	5850	$ 117950
Granite Peak	1		40	9800	30	2	1	4	0	137200	9000	12000	20000	35000	40000	0	$ 253200
Conter Hill	1		44	7300	30	4	1	4	0	274400	18000	12000	26000	35000	40000	0	$ 405400
Bozeman	1	121	10	5000	30	1	0	1	0	68600	4500	12000	17000	0	10000	39325	$ 151425
Livingston	0	21	10	4500	40	1	0	1	0	68600	4500	16000	17000	0	10000	6825	$ 122925
Grey Cliff	1		56	5090	30	3	0	3	0	205800	13500	12000	23000	0	30000	0	$ 284300
Big Timber	0	14	14	3870	30	1	0	1	0	68600	4500	12000	17000	0	10000	4550	$ 116650
West Pryor Mt.	1		61	6690	30	3	1	2	0	205800	13500	12000	23000	35000	20000	0	$ 309300
Billings	1	98	32	3200	50	1	0	1	0	68600	4500	20000	17000	0	10000	31850	$ 151950
SUBTOTALS										3139800	193500	388000	451000	385000	500000	271050	$ 5328350
Total Cost For Former Tel Pak Points										$ 4969200							

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bdg O/I	Pts Site Prep	RF Rpt O/I	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
										Technical Details			Extended Costs				
SUBTOTALS										3139800	193500	388000	451000	385000	500000	271050	5328350
Pryor Creek	1		35	4200	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Sarpy	1		61	4800	30	3	1	2	0	205800	13500	12000	23000	35000	20000	0	$ 309300
Forsyth	1	16	32	3200	30	1	0	1	0	68600	4500	12000	17000	0	10000	5200	$ 117300
Liscom Butte	1		45	4317	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Signal Butte	1		46	2900	230	3	1	2	0	205800	13500	92000	23000	35000	20000	0	$ 389300
Miles City	1	31	6	2500	40	1	0	1	0	68600	4500	16000	17000	0	10000	10075	$ 126175
Coal Creek	0		43	2900	180	2	1	2	0	137200	9000	72000	20000	35000	20000	0	$ 293200
Glendive Knob	0		30	2600	110	3	1	2	0	205800	13500	44000	23000	35000	20000	0	$ 341300
Glendive	0	180	8	2180	190	1	0	1	0	68600	4500	76000	17000	0	10000	58500	$ 234600
Elm Coulee	0		34	2500	250	3	1	3	0	205800	13500	100000	23000	35000	30000	0	$ 407300
Sidney	0	22	20	2000	30	1	0	1	0	68600	4500	12000	17000	0	10000	7150	$ 119250
N. F. Redwater	0		39	2700	150	2	1	2	0	137200	9000	60000	20000	35000	20000	0	$ 281200
Sheep Creek	0		35	2500	150	0	0	1	1	95000	0	60000	0	0	10000	0	$ 165000
Wolf Point	0	18	12	2000	50	2	0	1	0	137200	9000	20000	20000	0	10000	5850	$ 202050
Lost Creek	0		31	2700	100	0	0	1	1	95000	0	40000	0	0	10000	0	$ 145000
Coyote Creek	0		22	2400	30	3	1	2	0	205800	13500	12000	23000	35000	20000	0	$ 309300
Glasgow	0	29	3	2090	40	1	0	1	0	68600	4500	16000	17000	0	10000	9425	$ 125525
Willow Creek	0		28	3100	60	2	1	1	0	137200	9000	24000	20000	35000	10000	0	$ 235200
Zortman	1		62	5500	30	3	1	2	0	205800	13500	12000	23000	35000	20000	0	$ 309300
Bear Paws	1		45	5900	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Havre	1	26	24	2600	100	2	1	1	0	137200	9000	40000	20000	35000	10000	8450	$ 259650
Chester	0		42	3600	80	2	1	2	0	137200	9000	32000	20000	35000	20000	0	$ 253200
Mt. Royal	0		27	6900	30	3	1	2	0	205800	13500	12000	23000	35000	20000	0	$ 309300
Cut Bank	0	14	56	3850	100	1	0	1	0	68600	4500	40000	17000	0	10000	4550	$ 144650
Shelby	0	23	31	3290	50	1	0	1	0	68600	4500	20000	17000	0	10000	7475	$ 127575
Radar Site	1		57	6400	30	3	1	1	0	205800	13500	12000	23000	35000	10000	0	$ 299300
Lewistown	1	34	5	3700	40	1	0	1	0	68600	4500	16000	17000	0	10000	11050	$ 127150
Hughesville	1		54	8600	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Great Falls	1	222	44	3600	150	2	0	1	0	137200	9000	60000	20000	0	10000	72150	$ 308350
Shell Rock Ridge	1		41	7800	30	2	1	2	0	137200	9000	12000	20000	35000	20000	0	$ 233200
Helena	1	185	29	4000	0	1	0	1	0	68600	4500	0	17000	0	10000	60125	$ 160225
TOTALS										7240000	450000	1360000	1028000	1015000	970000	531050	$ 12594050

Total Cost For Former Tel Pak Points $ 8741250

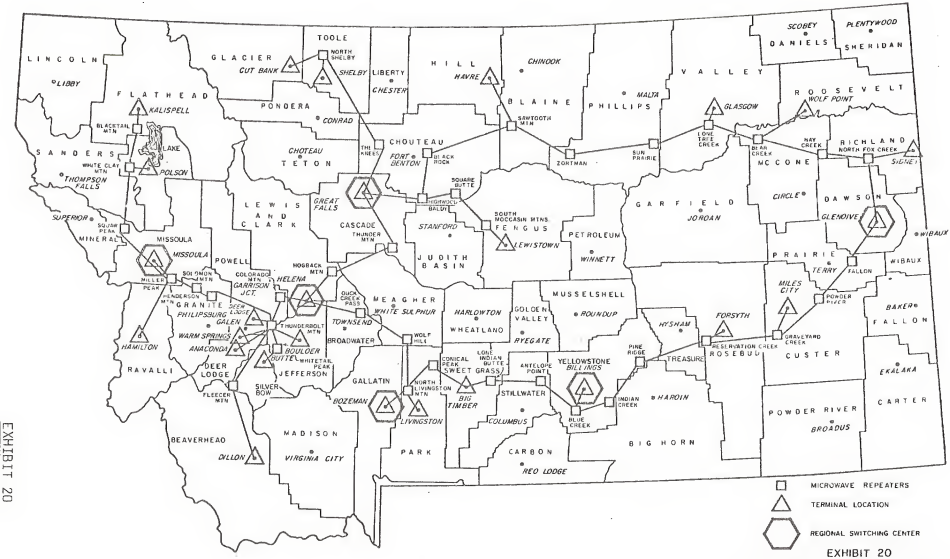


EXHIBIT 20

EXHIBIT 20

STATE OF MONTANA
PROPOSED
MICROWAVE TRANSMISSION SYSTEM
PLAN II

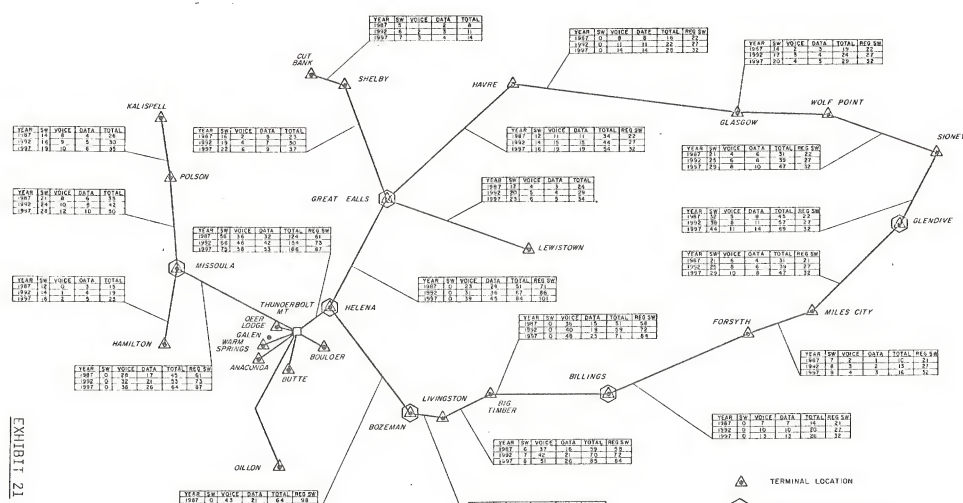


EXHIBIT 21

* REG SW - SWITCHED TRUNKS FROM REGIONAL CENTER TO HELENA BASE
SW - SWITCHED TRUNKS FROM TERMINAL LOCATION OR LOCAL SWITCH

EXHIBIT 21

STATE OF MONTANA

TRUNKING DIAGRAM

MICROWAVE TRANSMISSION SYSTEM

PLAN II

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Analog Microwave
1997 System Quantities
Plan 2-West Route

RF Terminal Cost/Unit	$ 29900	Channel Equip/Circuit	$ 1400
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
		Technical Details								Extended Costs							
HELENA-WEST	1	276		4090	50	1	1	1	0	29900	4500	20000	17000	35000	10000	386400	$ 502800
Colorado Mt.	1		15	7223	50	1	1	4	0	29900	4500	20000	17000	35000	40000	0	$ 146400
Thunder Bolt Mt.	1		17	8597	80	7	1	4	0	209300	31500	32000	35000	35000	40000	0	$ 382800
Boulder	1	14	18	4400	200	1	0	1	0	29900	4500	80000	17000	0	10000	19600	$ 161000
Deer Lodge	1	19	14	4521	40	1	0	1	0	29900	4500	16000	17000	0	10000	26600	$ 104000
Warm Springs/Galen	1	8	19	4420	40	1	0	1	0	29900	4500	16000	17000	0	10000	11200	$ 88600
Anaconda	1	19	28	5265	30	1	0	1	0	29900	4500	12000	17000	0	10000	26600	$ 100000
White Tail Peak	1		19	8475	60	0	0	3	1	95000	0	24000	0	0	30000	0	$ 149000
Butte	1	44	10	5549	40	1	0	1	0	29900	4500	16000	17000	0	10000	61600	$ 139000
Mount Fleecer	1		39	9436	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Dillon	1	18	44	5096	40	1	0	1	0	29900	4500	16000	17000	0	10000	25200	$ 102600
Henderson Mt.	1		43	7087	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Solomon Mt.	1		22	6916	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Miller Peak	1		13	7018	50	2	1	4	0	59800	9000	20000	20000	35000	40000	0	$ 183800
Hamilton	0	23	38	4100	30	1	0	1	0	29900	4500	12000	17000	0	10000	32200	$ 105600
Missoula	1	224	10	3227	40	1	0	1	0	29900	4500	16000	17000	0	10000	313600	$ 391000
Squaw Peak	1		36	7996	30	0	0	3	1	95000	0	12000	0	0	30000	0	$ 137000
White Clay Mt.	1		35	5680	30	2	1	4	0	59800	9000	12000	20000	35000	40000	0	$ 175800
Polson	1	15	31	3022	30	1	0	1	0	29900	4500	12000	17000	0	10000	21000	$ 94400
Blacktail Mt.	1		26	6757	30	0	1	2	1	95000	0	12000	0	35000	20000	0	$ 162000
Kalispell	1	35	16	3000	30	1	0	1	0	29900	4500	12000	17000	0	10000	49000	$ 122400
TOTALS										1257700	103500	420000	279000	210000	440000	973000	3683200

Total Route Cost For Former Tel Pak Points $ 3577600

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Analog Microwave
1997 System Quantities
Plan 2-East Route

RF Terminal Cost/Unit	$ 29900	Channel Equip/Circuit	$ 1400
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns		Total
HELENA-EAST	1	241		4090	50	1	0	1	0	29900	4500	20000	17000	0	10000	337400	$	418800
Duck Creek Pass	1		38	7515	60	0	0	3	1	95000	0	24000	0	0	30000	0	$	149000
Wolf Hill	1		36	6662	50	0	0	2	1	95000	0	20000	0	0	20000	0	$	135000
No. Livingston Mt.	1		31	7964	60	4	1	3	0	119600	18000	24000	26000	35000	30000	0	$	252600
Bozeman	1	108	14	4810	50	1	0	1	0	29900	4500	20000	17000	0	10000	151200	$	232600
Livingston	0	21	12	4503	40	1	0	1	0	29900	4500	16000	17000	0	10000	29400	$	106800
Conical Peak	1		28	10731	50	0	0	3	1	95000	0	20000	0	0	30000	0	$	145000
Big Timber	1	14	28	3870	30	2	0	1	0	59800	9000	12000	20000	0	10000	19600	$	130400
Lone Indian Butte	1		19	5197	40	0	0	1	1	95000	0	16000	0	0	10000	0	$	121000
Antelope Point	1		28	4560	40	2	1	2	0	59800	9000	16000	20000	35000	20000	0	$	159800
Blue Creek Rptr	1		29	4000	40	3	1	2	0	89700	13500	16000	23000	35000	20000	0	$	197200
Billings	1	98	10	3124	50	1	0	1	0	29900	4500	20000	17000	0	10000	137200	$	218600
Indian Creek Rptr	1		20	4204	40	0	0	1	1	95000	0	16000	0	0	10000	0	$	121000
Pine Ridge	1		32	3777	50	2	1	1	0	59800	9000	20000	20000	35000	10000	0	$	153800
Reservation Creek	1		40	3500	100	3	1	1	0	89700	13500	40000	23000	35000	10000	0	$	211200
Forsyth	1	16	12	3200	30	1	0	1	0	29900	4500	12000	17000	0	10000	22400	$	95800
Graveyard Creek	1		39	3000	150	3	1	1	0	89700	13500	60000	23000	35000	10000	0	$	231200
Miles City	1	31	18	2500	40	1	0	1	0	29900	4500	16000	17000	0	10000	43400	$	120800
Powder River Rptr	0		38	3343	180	2	1	1	0	59800	9000	72000	20000	35000	10000	0	$	205800
Fallon Creek Rptr	0		26	2665	120	2	1	1	0	59800	9000	48000	20000	35000	10000	0	$	181800
Glendive	0	90	29	2180	190	1	0	1	0	29900	4500	76000	17000	0	10000	126000	$	263400
TOTALS										1372000	135000	584000	314000	280000	300000	866600	$	3851600

Total Route Cost For Former Tel Pak Points $ 3093800

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Analog Microwave
1997 System Quantities
Plan 2-North Route

RF Terminal Cost/Unit	$ 29900	Channel Equip/Circuit	$ 1400
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
	Technical Details									Extended Costs							
HELENA-NORTH	1	101		4090	50	1	0	1	0	29900	4500	20000	17000	0	10000	141400	$ 222800
Hog Back Mt.	1		22	7813	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Thunder Mt.	1		41	8050	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Great Falls	1	101	38	3336	250	3	0	1	0	89700	13500	100000	23000	0	10000	141400	$ 377600
The Knees	0		36	3500	50	0	0	1	1	95000	0	20000	0	0	10000	0	$ 125000
Shelby North Rptr	0		42	3500	50	3	1	2	0	89700	13500	20000	23000	35000	20000	0	$ 201200
Shelby	0	23	1	3286	30	1	0	1	0	29900	4500	12000	17000	0	10000	32200	$ 105600
Cut Bank	0	14	25	3340	50	1	0	1	0	29900	4500	20000	17000	0	10000	19600	$ 101000
Highwood Baldy	1		32	7625	50	3	0	0	0	89700	13500	20000	23000	0	0	0	$ 146200
Square Butte	1		19	5684	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
S Mocassin Mt Rptr	1		41	4080	40	0	0	2	1	95000	0	16000	0	0	20000	0	$ 131000
Lewistown	1	34	8	3693	40	1	0	1	0	29900	4500	16000	17000	0	10000	47600	$ 125000
Black Rock	1		42	3002	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
Sawtooth Mt.	1		39	5246	50	3	1	3	0	89700	13500	20000	23000	35000	30000	0	$ 211200
Havre	1	26	37	2529	40	1	0	1	0	29900	4500	16000	17000	0	10000	36400	$ 113800
Zortman	0		41	5500	40	2	1	3	0	59800	9000	16000	20000	35000	30000	0	$ 169800
Sun Prairie	0		43	2500	200	2	1	2	0	59800	9000	80000	20000	35000	20000	0	$ 223800
Lone Tree Creek	0		34	2500	180	3	1	2	0	89700	13500	72000	23000	35000	20000	0	$ 253200
Glasgow	0	29	23	2090	40	1	0	1	0	29900	4500	16000	17000	0	10000	40600	$ 118000
Bear Creek	0		39	2500	200	3	1	2	0	89700	13500	80000	23000	35000	20000	0	$ 261200
Wolf Point	0	18	27	2678	40	1	0	1	0	29900	4500	16000	17000	0	10000	25200	$ 102600
Hay Creek	0		40	2500	200	0	0	0	1	95000	0	80000	0	0	0	0	$ 175000
North Fox Creek	0		40	2500	200	3	1	2	0	89700	13500	80000	23000	35000	20000	0	$ 261200
Sidney	0	22	16	1829	50	1	0	1	0	29900	4500	20000	17000	0	10000	30800	$ 112200
Glendive	0	10i	40	2180	190	1	0	1	0	29900	4500	76000	17000	0	10000	141400	$ 278800
TOTALS										1651700	148500	800000	337000	245000	360000	515200	$ 4057400

Total Route Cost For Former Tel Pak Points $ 1847600

PLAN TOTAL: $11,592,200

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave
1997 System Quantities
Plan 2-North Route

MEDIUM DENSITY

RF Terminal Cost/Unit	$ 68600	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
HELENA-NORTH	1	101		4090	50	1	0	1	0	68600	4500	20000	17000	0	10000	32825	$ 152925
Hog Back Mt.	1		22	7813	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Thunder Mt.	1		41	8050	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Great Falls	1	101	38	3336	250	3	0	1	0	205800	13500	100000	23000	0	10000	32825	$ 385125
The Knees	0		36	3500	50	0	0	1	1	95000	0	20000	0	0	10000	0	$ 125000
Shelby North Rptr	0		42	3500	50	3	1	2	0	205800	13500	20000	23000	35000	20000	0	$ 317300
Shelby	0	23	1	3286	30	1	0	1	0	68600	4500	12000	17000	0	10000	7475	$ 119575
Cut Bank	0	14	25	3340	50	1	0	1	0	68600	4500	20000	17000	0	10000	4550	$ 124650
Highwood Baldy	1		32	7625	50	3	0	0	0	205800	13500	20000	23000	0	0	0	$ 262300
Square Butte	1		19	5684	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
S Mocassin Mt Rptr	1		41	4080	40	0	0	2	1	95000	0	16000	0	0	20000	0	$ 131000
Lewistown	1	34	8	3693	40	1	0	1	0	68600	4500	16000	17000	0	10000	11050	$ 127150
Black Rock	1		42	3002	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
Sawtooth Mt.	1		39	5246	50	3	1	3	0	205800	13500	20000	23000	35000	30000	0	$ 327300
Havre	1	26	37	2529	40	1	0	1	0	68600	4500	16000	17000	0	10000	8450	$ 124550
Zortman	0		41	5500	40	2	1	3	0	137200	9000	16000	20000	35000	30000	0	$ 247200
Sun Prairie	0		43	2500	200	2	1	2	0	137200	9000	80000	20000	35000	20000	0	$ 301200
Lone Tree Creek	0		34	2500	180	3	1	2	0	205800	13500	72000	23000	35000	20000	0	$ 369300
Glasgow	0	29	23	2090	40	1	0	1	0	68600	4500	16000	17000	0	10000	9425	$ 125525
Bear Creek	0		39	2500	200	3	1	2	0	205800	13500	80000	23000	35000	20000	0	$ 377300
Wolf Point	0	18	27	2678	40	1	0	1	0	68600	4500	16000	17000	0	10000	5850	$ 121950
Hay Creek	0		40	2500	200	0	0	0	1	95000	0	80000	0	0	0	0	$ 175000
North Fox Creek	0		40	2500	200	3	1	2	0	205800	13500	80000	23000	35000	20000	0	$ 377300
Sidney	0	22	16	1829	50	1	0	1	0	68600	4500	20000	17000	0	10000	7150	$ 127250
Glendive	0	101	40	2180	190	1	0	1	0	68600	4500	76000	17000	0	10000	32825	$ 208925
TOTALS										2928800	148500	800000	337000	245000	360000	119600	$ 4938900

Total Route Cost For Former Tel Pak Points $ 2030350

STATE of MONTANA

MEDIUM DENSITY

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave
1997 System Quantities
Plan 2-West Route

RF Terminal Cost/Unit	$ 68600	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
HELENA-WEST	1	276		4090	50	1	1	1	0	68600	4500	20000	17000	35000	10000	89700	$ 244800
Colorado Mt.	1		15	7223	50	1	1	4	0	68600	4500	20000	17000	35000	40000	0	$ 185100
Thunder Bolt Mt.	1		17	8597	80	7	1	4	0	480200	31500	32000	35000	35000	40000	0	$ 653700
Boulder	1	14	18	4400	200	1	0	1	0	68600	4500	80000	17000	0	10000	4550	$ 184650
Deer Lodge	1	19	14	4521	40	1	0	1	0	68600	4500	16000	17000	0	10000	6175	$ 122275
Warm Springs/Galen	1	8	19	4420	40	1	0	1	0	68600	4500	16000	17000	0	10000	2600	$ 118700
Anaconda	1	19	28	5265	30	1	0	1	0	68600	4500	12000	17000	0	10000	6175	$ 118275
White Tail Peak	1		19	8475	60	0	0	3	1	95000	0	24000	0	0	30000	0	$ 149000
Butte	1	44	10	5549	40	1	0	1	0	68600	4500	16000	17000	0	10000	14300	$ 130400
Mount Fleecer	1		39	9436	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Dillon	1	18	44	5096	40	1	0	1	0	68600	4500	16000	17000	0	10000	5850	$ 121950
Henderson Mt.	1		43	7087	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Solomon Mt.	1		22	6916	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Miller Peak	1		13	7018	50	2	1	4	0	137200	9000	20000	20000	35000	40000	0	$ 261200
Hamilton	0	23	38	4100	30	1	0	1	0	68600	4500	12000	17000	0	10000	7475	$ 119575
Missoula	1	224	10	3227	40	1	0	1	0	68600	4500	16000	17000	0	10000	72800	$ 188900
Squaw Peak	1		36	7996	30	0	0	3	1	95000	0	12000	0	0	30000	0	$ 137000
White Clay Mt.	1		35	5680	30	2	1	4	0	137200	9000	12000	20000	35000	40000	0	$ 253200
Polson	1	15	31	3022	30	1	0	1	0	68600	4500	12000	17000	0	10000	4875	$ 116975
Blacktail Mt.	1		26	6757	30	0	1	2	1	95000	0	12000	0	35000	20000	0	$ 162000
Kalispell	1	35	16	3000	30	1	0	1	0	68600	4500	12000	17000	0	10000	11375	$ 123475
TOTALS										2147800	103500	420000	279000	210000	440000	225875	3826175

Total Route Cost For Former Tel Pak Points $ 3706600

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave
1997 System Quantities
Plan 2-East Route

MEDIUM DENSITY

RF Terminal Cost/Unit	$ 68600	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst$	14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
	---Technical Details---									---Extended Costs---							
HELENA-EAST	1	241		4090	50	1	0	1	0	68600	4500	20000	17000	0	10000	78325	$ 198425
Duck Creek Pass	1		38	7515	60	0	0	3	1	95000	0	24000	0	0	30000	0	$ 149000
Wolf Hill	1		36	6662	50	0	0	2	1	95000	0	20000	0	0	20000	0	$ 135000
No. Livingston Mt.	1		31	7964	60	4	1	3	0	274400	18000	24000	26000	35000	30000	0	$ 407400
Bozeman	1	108	14	4810	50	1	0	1	0	68600	4500	20000	17000	0	10000	35100	$ 155200
Livingston	0	21	12	4503	40	1	0	1	0	68600	4500	16000	17000	0	10000	6825	$ 122925
Conical Peak	1		28	10731	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Big Timber	1	14	28	3870	30	2	0	1	0	137200	9000	12000	20000	0	10000	4550	$ 192750
Lone Indian Butte	1		19	5197	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Antelope Point	1		28	4560	40	2	1	2	0	137200	9000	16000	20000	35000	20000	0	$ 237200
Blue Creek Rptr	1		29	4000	40	3	1	2	0	205800	13500	16000	23000	35000	20000	0	$ 313300
Billings	1	98	10	3124	50	1	0	1	0	68600	4500	20000	17000	0	10000	31850	$ 151950
Indian Creek Rptr	1		20	4204	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Pine Ridge	1		32	3777	50	2	1	1	0	137200	9000	20000	20000	35000	10000	0	$ 231200
Reservation Creek	1		40	3500	100	3	1	1	0	205800	13500	40000	23000	35000	10000	0	$ 327300
Forsyth	1	16	12	3200	30	1	0	1	0	68600	4500	12000	17000	0	10000	5200	$ 117300
Graveyard Creek	1		39	3000	150	3	1	1	0	205800	13500	60000	23000	35000	10000	0	$ 347300
Miles City	1	31	18	2500	40	1	0	1	0	68600	4500	16000	17000	0	10000	10075	$ 126175
Powder River Rptr	0		38	3343	180	2	1	1	0	137200	9000	72000	20000	35000	10000	0	$ 283200
Fallon Creek Rptr	0		26	2665	120	2	1	1	0	137200	9000	48000	20000	35000	10000	0	$ 259200
Glendive	0	90	29	2180	190	1	0	1	0	68600	4500	76000	17000	0	10000	29250	$ 205350
TOTALS										2533000	135000	584000	314000	280000	300000	201175	$ 4347175

Total Route Cost For Former Tel Pak Points $ 3476500

PLAN TOTAL: $13,112,250

STATE of MONTANA

LOW DENSITY

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave-Low Density
1997 System Quantities
Plan 2-North Route

RF Terminal Cost/Unit	$ 56900	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst$	14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
HELENA-NORTH	1	101		4090	50	1	0	1	0	56900	4500	20000	17000	0	10000	32825	$ 141225
Hog Back Mt.	1		22	7813	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Thunder Mt.	1		41	8050	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Great Falls	1	101	38	3336	250	3	0	1	0	170700	13500	100000	23000	0	10000	32825	$ 350025
The Knees	0		36	3500	50	0	0	1	1	95000	0	20000	0	0	10000	0	$ 125000
Shelby North Rptr	0		42	3500	50	3	1	2	0	170700	13500	20000	23000	35000	20000	0	$ 282200
Shelby	0	23	1	3286	30	1	0	1	0	56900	4500	12000	17000	0	10000	7475	$ 107875
Cut Bank	0	14	25	3340	50	1	0	1	0	56900	4500	20000	17000	0	10000	4550	$ 112950
Highwood Baldy	1		32	7625	50	3	0	0	0	170700	13500	20000	23000	0	0	0	$ 227200
Square Butte	1		19	5684	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
S Mocassin Mt Rptr	1		41	4080	40	0	0	2	1	95000	0	16000	0	0	20000	0	$ 131000
Lewistown	1	34	8	3693	40	1	0	1	0	56900	4500	16000	17000	0	10000	11050	$ 115450
Black Rock	1		42	3002	30	0	0	2	1	95000	0	12000	0	0	20000	0	$ 127000
Sawtooth Mt.	1		39	5246	50	3	1	3	0	170700	13500	20000	23000	35000	30000	0	$ 292200
Havre	1	26	37	2529	40	1	0	1	0	56900	4500	16000	17000	0	10000	8450	$ 112850
Zortman	0		41	5500	40	2	1	3	0	113800	9000	16000	20000	35000	30000	0	$ 223800
Sun Prairie	0		43	2500	200	2	1	2	0	113800	9000	80000	20000	35000	20000	0	$ 277800
Lone Tree Creek	0		34	2500	180	3	1	2	0	170700	13500	72000	23000	35000	20000	0	$ 334200
Glasgow	0	29	23	2090	40	1	0	1	0	56900	4500	16000	17000	0	10000	9425	$ 113825
Bear Creek	0		39	2500	200	3	1	2	0	170700	13500	80000	23000	35000	20000	0	$ 342200
Wolf Point	0	18	27	2678	40	1	0	1	0	56900	4500	16000	17000	0	10000	5850	$ 110250
Hay Creek	0		40	2500	200	0	0	0	1	95000	0	80000	0	0	0	0	$ 175000
North Fox Creek	0		40	2500	200	3	1	2	0	170700	13500	80000	23000	35000	20000	0	$ 342200
Sidney	0	22	16	1829	50	1	0	1	0	56900	4500	20000	17000	0	10000	7150	$ 115550
Glendive	0	101	40	2180	190	1	0	1	0	56900	4500	76000	17000	0	10000	32825	$ 197225
TOTALS										2542700	148500	800000	337000	245000	360000	119600	$ 4552800

Total Route Cost For Former Tel Pak Points $ 1889950

LOW DENSITY

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave-Low Density
1997 System Quantities
Plan 2-West Route

RF Terminal Cost/Unit	$ 56900	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
HELENA-WEST	1	276		4090	50	1	1	1	0	56900	4500	20000	17000	35000	10000	89700	$ 233100
Colorado Mt.	1		15	7223	50	1	1	4	0	56900	4500	20000	17000	35000	40000	0	$ 173400
Thunder Bolt Mt.	1		17	8597	80	7	1	4	0	398300	31500	32000	35000	35000	40000	0	$ 571800
Boulder	1	14	18	4400	200	1	0	1	0	56900	4500	80000	17000	0	10000	4550	$ 172950
Deer Lodge	1	19	14	4521	40	1	0	1	0	56900	4500	16000	17000	0	10000	6175	$ 110575
Warm Springs/Galen	1	8	19	4420	40	1	0	1	0	56900	4500	16000	17000	0	10000	2600	$ 107000
Anaconda	1	19	28	5265	30	1	0	1	0	56900	4500	12000	17000	0	10000	6175	$ 106575
White Tail Peak	1		19	8475	60	0	0	3	1	95000	0	24000	0	0	30000	0	$ 149000
Butte	1	44	10	5549	40	1	0	1	0	56900	4500	16000	17000	0	10000	14300	$ 118700
Mount Fleecer	1		39	9436	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Dillon	1	18	44	5096	40	1	0	1	0	56900	4500	16000	17000	0	10000	5850	$ 110250
Henderson Mt.	1		43	7087	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Solomon Mt.	1		22	6916	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Miller Peak	1		13	7018	50	2	1	4	0	113800	9000	20000	20000	35000	40000	0	$ 237800
Hamilton	0	23	38	4100	30	1	0	1	0	56900	4500	12000	17000	0	10000	7475	$ 107875
Missoula	1	224	10	3227	40	1	0	1	0	56900	4500	16000	17000	0	10000	72800	$ 177200
Squaw Peak	1		36	7996	30	0	0	3	1	95000	0	12000	0	0	30000	0	$ 137000
White Clay Mt.	1		35	5680	30	2	1	4	0	113800	9000	12000	20000	35000	40000	0	$ 229800
Polson	1	15	31	3022	30	1	0	1	0	56900	4500	12000	17000	0	10000	4875	$ 105275
Blacktail Mt.	1		26	6757	30	0	1	2	1	95000	0	12000	0	35000	20000	0	$ 162000
Kalispell	1	35	16	3000	30	1	0	1	0	56900	4500	12000	17000	0	10000	11375	$ 111775
TOTALS										1878700	103500	420000	279000	210000	440000	225875	3557075

Total Route Cost For Former Tel Pak Points $ 3449200

STATE of MONTANA

LOW DENSITY

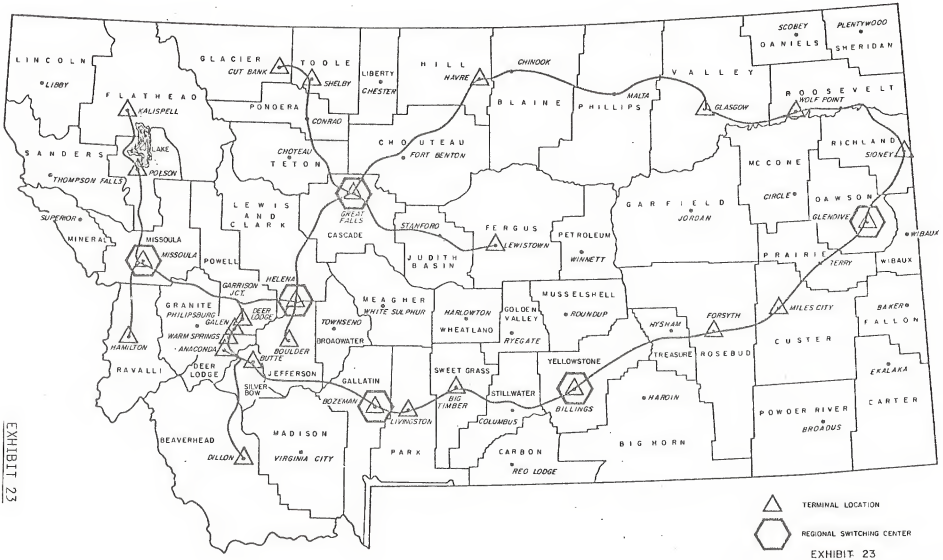
MICROWAVE TRANSMISSION SYSTEM
Digital Microwave-Low Density
1997 System Quantities
Plan 2-East Route

RF Terminal Cost/Unit	$ 56900	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Pwr Tel Pak ?	# Ckt	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
		Trm															
HELENA-EAST	1	241		4090	50	1	0	1	0	56900	4500	20000	17000	0	10000	78325	$ 186725
Duck Creek Pass	1		38	7515	60	0	0	3	1	95000	0	24000	0	0	30000	0	$ 149000
Wolf Hill	1		36	6662	50	0	0	2	1	95000	0	20000	0	0	20000	0	$ 135000
No. Livingston Mt.	1		31	7964	60	4	1	3	0	227600	18000	24000	26000	35000	30000	0	$ 360600
Bozeman	1	108	14	4810	50	1	0	1	0	56900	4500	20000	17000	0	10000	35100	$ 143500
Livingston	0	21	12	4503	40	1	0	1	0	56900	4500	16000	17000	0	10000	6825	$ 111225
Conical Peak	1		28	10731	50	0	0	3	1	95000	0	20000	0	0	30000	0	$ 145000
Big Timber	1	14	28	3870	30	2	0	1	0	113800	9000	12000	20000	0	10000	4550	$ 169350
Lone Indian Butte	1		19	5197	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Antelope Point	1		28	4560	40	2	1	2	0	113800	9000	16000	20000	35000	20000	0	$ 213800
Blue Creek Rptr	1		29	4000	40	3	1	2	0	170700	13500	16000	23000	35000	20000	0	$ 278200
Billings	1	98	10	3124	50	1	0	1	0	56900	4500	20000	17000	0	10000	31850	$ 140250
Indian Creek Rptr	1		20	4204	40	0	0	1	1	95000	0	16000	0	0	10000	0	$ 121000
Pine Ridge	1		32	3777	50	2	1	1	0	113800	9000	20000	20000	35000	10000	0	$ 207800
Reservation Creek	1		40	3500	100	3	1	1	0	170700	13500	40000	23000	35000	10000	0	$ 292200
Forsyth	1	16	12	3200	30	1	0	1	0	56900	4500	12000	17000	0	10000	5200	$ 105600
Graveyard Creek	1		39	3000	150	3	1	1	0	170700	13500	60000	23000	35000	10000	0	$ 312200
Miles City	1	31	18	2500	40	1	0	1	0	56900	4500	16000	17000	0	10000	10075	$ 114475
Powder River Rptr	0		38	3343	180	2	1	1	0	113800	9000	72000	20000	35000	10000	0	$ 259800
Fallon Creek Rptr	0		26	2665	120	2	1	1	0	113800	9000	48000	20000	35000	10000	0	$ 235800
Glendive	0	90	29	2180	190	1	0	1	0	56900	4500	76000	17000	0	10000	29250	$ 193650
TOTALS										2182000	135000	584000	314000	280000	300000	201175	$ 3996175

Total Route Cost For Former Tel Pak Points $ 3195700

PLAN TOTAL: $12,106,050



TERMINAL LOCATION

REGIONAL SWITCHING CENTER

EXHIBIT 23

STATE OF MONTANA

FIBER OPTIC TRANSMISSION SYSTEM

EXHIBIT 23

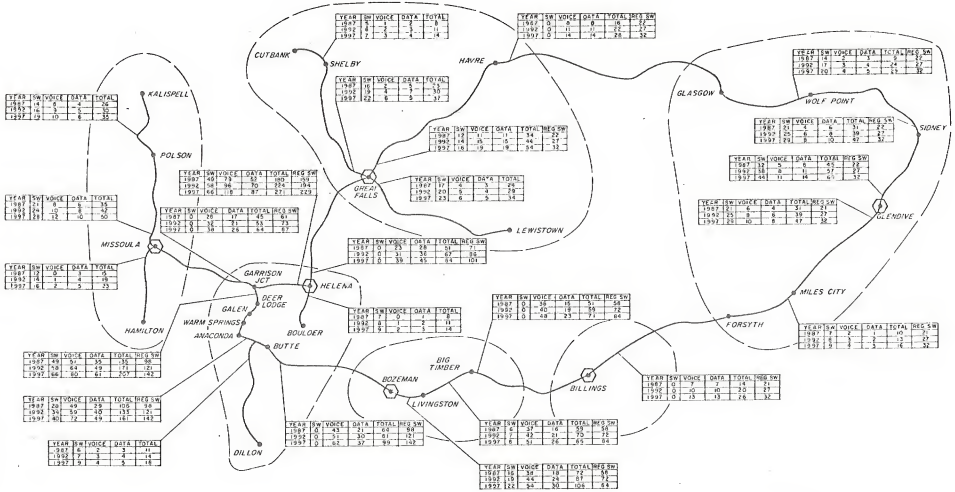


EXHIBIT 24

REGIONAL SWITCHING CENTER

REG SW - SWITCHED TRUNKS FROM REGIONAL CENTER TO HELENA BASE
SW - SWITCHED TRUNKS FROM TERMINAL LOCATION OR LOCAL SWITCH

EXHIBIT 24

STATE OF MONTANA

TRUNKING DIAGRAM

FIBER OPTIC TRANSMISSION SYSTEM

STATE of MONTANA

FIBER OPTIC TRANSMISSION SYSTEM
1997 System Cost

Fiber Cable Cost/Fiber-M	.80
Sheath & Burial Cost/M	4.00
Repeater Cost/Fiber	12500.00
Multiplex Cost/DS-1	3000.00
Channel Cost/Channel	325.00

Section	Fmr Tel Pak	Technical Data Ckt Qty	Mi	# Fbr	# DS-1	# Rpt	Section Cost Cable	Rptr	MUX	Chn	Total Cost
Helena-Garrison Jct	1		46	8	32	24	769910	300000	96000	0	$ 1165910
Helena-Boulder	1	14	29	2	8	4	261357	50000	24000	4550	$ 339907
Garrison Jct-Deer Lodge	1	19	11	6	24		155784	0	72000	6175	$ 233959
Deer Lodge-Anaconda	1	19	11	6	24		155784	0	72000	6175	$ 233959
Anaconda-Dillon	1	18	67	2	8	10	603826	125000	24000	5850	$ 758676
Anaconda-Butte	1	44	30	5	20	10	386243	125000	60000	14300	$ 585543
Butte-Bozeman	1	51	85	5	24	30	1094354	375000	72000	16575	$ 1557929
Bozeman-Livingston	1	21	26	4	16	8	301269	100000	48000	6825	$ 456094
Livingston-Big Timber	1	14	36	4	16	8	417142	100000	48000	4550	$ 569692
Big Timber-Billings	1	98	84	4	16	24	973331	300000	48000	31850	$ 1353181
Billings-Forsyth	1	16	94	3	12	21	968181	262500	36000	5200	$ 1271881
Forsyth-Miles City	1	31	54	3	12	12	556189	150000	36000	10075	$ 752264
Miles City-Glendive	0	191	81	3	12	18	834284	225000	36000	62075	$ 1157359
Glendive-Sidney	0	22	55	3	12	12	566489	150000	36000	7150	$ 759639
Sidney-Wolf Point	0	18	93	3	12	21	957882	262500	36000	5850	$ 1262232
Wolf Point-Glasgow	0	29	52	3	12	12	535590	150000	36000	9425	$ 731015
Glasgow-Havre	0	26	161	3	12	36	1658268	450000	36000	8450	$ 2152718
Havre-Great Falls	1	186	115	3	12	27	1184477	337500	36000	60450	$ 1618427
Great Falls-Shelby	0	23	90	2	8	14	811109	175000	24000	7475	$ 1017584
Shelby-Cut Bank	0	14	26	2	8	4	234320	50000	24000	4550	$ 312870
Great Falls-Lewistown	1	34	108	2	8	16	973331	200000	24000	11050	$ 1208381
Great Falls-Helena	1	186	92	4	16	28	1066029	350000	48000	60450	$ 1524479
Garrrison Jct-Missoula	1	195	72	2	12	15	648888	187500	36000	63375	$ 935763
Missoula-Hamilton	0	23	48	2	8	8	432592	100000	24000	7475	$ 564067
Missoula-Polson	1	15	59	2	8	8	531727	100000	24000	4875	$ 660602
Polson-Kalispell	1	35	55	2	8	8	495678	100000	24000	11375	$ 631053
TOTAL							17574036	4725000	1080000	436150	$ 23815186

Total System Cost For Former Tel Pak Points $ 15857703

EXHIBIT 25

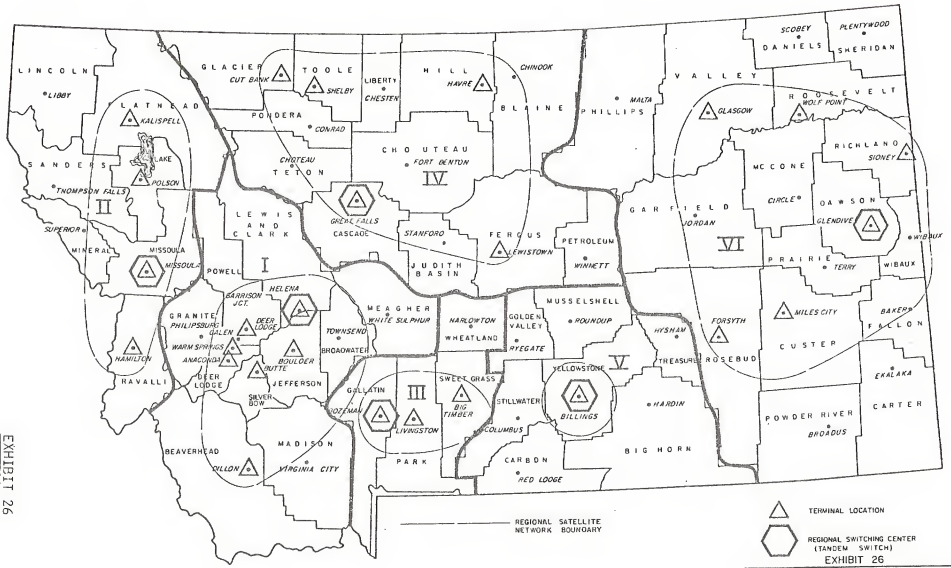


EXHIBIT 26

EXHIBIT 26

STATE OF MONTANA

PROPOSED

SATELLITE TRANSMISSION SYSTEM

STAR NETWORK DESIGN

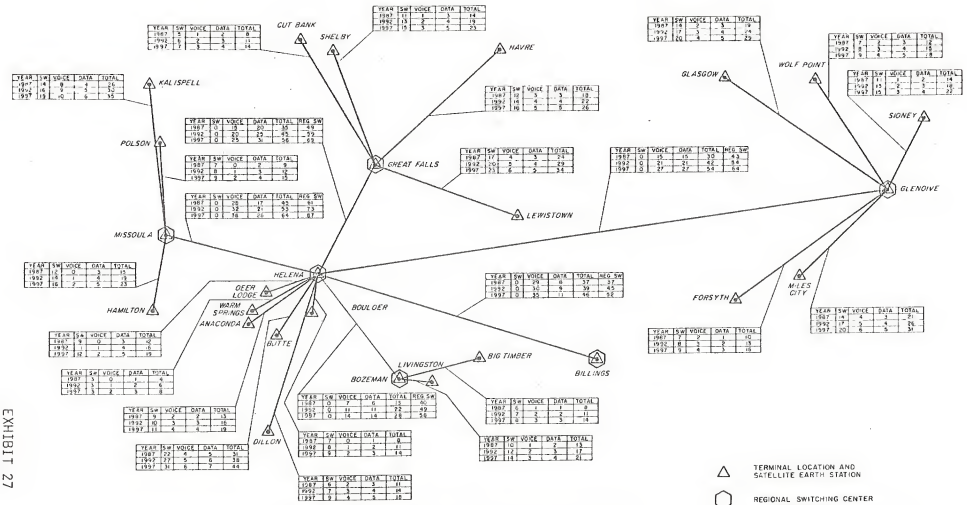


EXHIBIT 27

STATE OF MONTANA

PROPOSED SATELLITE TRANSMISSION SYSTEM TRUNKING PLAN

STATE of MONTANA

SATELLITE TRANSMISSION SYSTEM
Ground Segment Costs
Digital Satellite Plan
1997 System Quantities

TWT Cost/Watt	$ 500.00
RF Equipment Cost/Unit	$ 70000.00
Antenna Cost/Meter	$ 6000.00
D.C. Pwr Cost/Unit	$ 24000.00
Ctrl/Trk Equip Cost/Ckt	$ 4000.00
Building & Site Cost/Unit	$ 45000.00

Site	Former Tel Pak?	# Circuits	TWT Power	Ant Dia Meters	Costs: Antenna	RF Equip	DC Power	Ctrl/Trk	Building	Total
Anaconda	1	19	30	7	42000	85000	24000	76000	45000	$ 272000
Big Timber	0	14	30	7	42000	85000	24000	56000	45000	$ 252000
Billings	1	98	100	11	66000	120000	24000	392000	45000	$ 647000
Boulder	1	14	30	7	42000	85000	24000	56000	45000	$ 252000
Bozeman	1	62	100	11	66000	120000	24000	248000	45000	$ 503000
Butte	1	44	50	7	42000	95000	24000	176000	45000	$ 382000
Cutbank	0	14	30	7	42000	85000	24000	56000	45000	$ 252000
Deer Lodge	1	19	30	7	42000	85000	24000	76000	45000	$ 272000
Dillon	1	18	30	7	42000	85000	24000	72000	45000	$ 268000
Forsyth	1	16	30	7	42000	85000	24000	64000	45000	$ 260000
Glasgow	0	29	50	7	42000	95000	24000	116000	45000	$ 322000
Glendive	0	32	50	11	66000	95000	24000	128000	45000	$ 358000
Great Falls	1	53	75	11	66000	107500	24000	212000	45000	$ 454500
Hamilton	0	23	30	7	42000	85000	24000	92000	45000	$ 288000
Havre	1	26	50	7	42000	95000	24000	104000	45000	$ 310000
Helena	1	240	300	11	66000	220000	24000	960000	45000	$ 1315000
Kalispell	1	35	50	7	42000	95000	24000	140000	45000	$ 346000
Lewistown	1	34	50	7	42000	95000	24000	136000	45000	$ 342000
Livingston	0	21	30	7	42000	85000	24000	84000	45000	$ 280000
Miles City	1	31	50	7	42000	95000	24000	124000	45000	$ 330000
Missoula	1	97	100	11	66000	120000	24000	388000	45000	$ 643000
Polson	1	15	30	7	42000	85000	24000	60000	45000	$ 256000
Shelby	0	23	30	7	42000	85000	24000	92000	45000	$ 288000
Sidney	0	22	30	7	42000	85000	24000	88000	45000	$ 284000
Warm Springs/Galen	1	8	30	7	42000	85000	24000	32000	45000	$ 228000
Wolf Point	0	18	30	7	42000	85000	24000	72000	45000	$ 268000
TOTALS					1236000	2457500	600000	4024000	1125000	$ 9400500

Total System Cost For Former Tel Pak Points $ 6808500

EXHIBIT 28

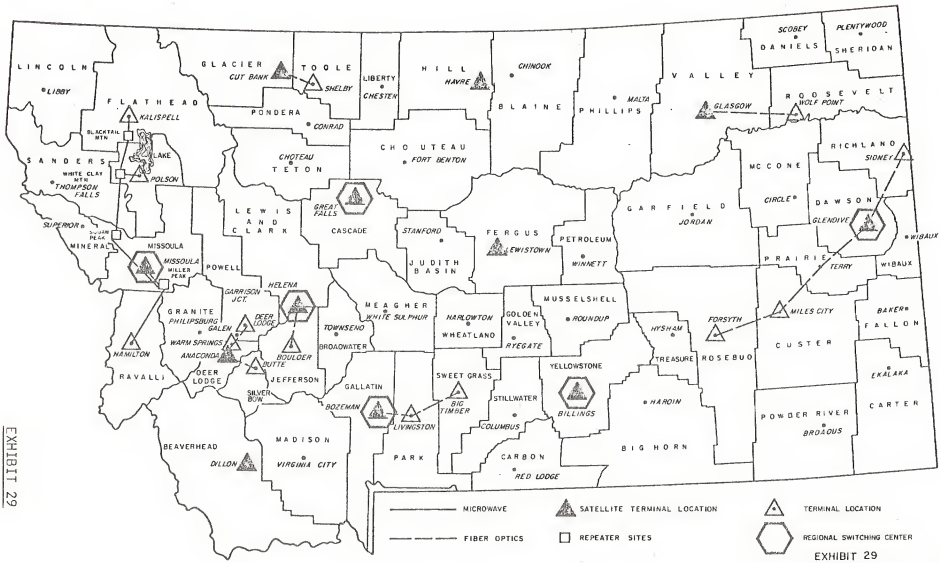


EXHIBIT 29

EXHIBIT 29

STATE OF MONTANA

PROPOSED TRANSMISSION SYSTEM

COMBINED TECHNOLOGY

STATE of MONTANA

FIBER OPTIC TRANSMISSION SYSTEM
-Combined Transmission Method-
1997 System Quantities

Fiber Cable Cst/Fiber-M	$ .80
Sheath & Burial Cost/M	$ 4.00
Repeater Cost/Fiber	$ 12500.00
Multiplex Cost/DS-1	$ 3000.00
Channel Cost/Channel	$ 325.00

Section	Fmr Tel Pak	Technical Data Ckt Qty	Mi	# Fbr	# DS-1	# Rpt	Section Cost Cable	Rptr	MUX	Chn	Total Cost
Deer Lodge-Warm Springs	1	27	16	2	2	0	144197	0	6000	8775	$ 158972
Warm Springs-Anaconda	1	27	10	2	2	0	90123	0	6000	8775	$ 104898
Butte-Anaconda	1	88	24	2	4	2	216296	25000	12000	28600	$ 281896
Big Timber-Livingston	1	35	37	2	2	2	333456	25000	6000	11375	$ 375831
Livingston-Bozeman	1	35	26	2	2	2	234320	25000	6000	11375	$ 276695
Shelby-Cut Bank	0	46	26	2	2	2	234320	25000	6000	14950	$ 280270
Wolf Point-Glasgow	0	36	52	2	2	6	468641	75000	6000	11700	$ 561341
Forsyth-Miles City	1	16	54	2	2	6	486666	75000	6000	5200	$ 572866
Miles City-Glendive	0	47	81	2	2	8	729998	100000	6000	15275	$ 851273
Sidney-Glendive	0	44	55	2	2	6	495678	75000	6000	14300	$ 590978
TOTAL							3433696	425000	66000	130325	$ 4055021

Total System Cost For Former Tel Pak Points $ 1771159

EXHIBIT 96
Page 1 of 3

STATE of MONTANA

SATELLITE TRANSMISSION SYSTEM
Ground Segment Costs
Digital Satellite Plan
-Combined Transmission Method-
1997 System Quantities

TWT Cost/Watt	$ 500.00
RF Equipment Cost/Unit	$ 70000.00
Antenna Cost/Meter	$ 6000.00
D.C. Pwr Cost/Unit	$ 24000.00
Ctrl/Trk Equip Cost/Ckt	$ 4000.00
Building & Site Cost/Unit	$ 45000.00

Site	Former Tel Pak?	# Circuits	TWT Power	Ant Dia Meters	Costs: Antenna	RF Equip	DC Power	Ctrl/Trk	Building		Total
Anaconda	1	17	100	7	42000	120000	24000	68000	45000	$	299000
Billings	1	98	100	11	66000	120000	24000	392000	45000	$	647000
Bozeman	1	86	100	7	42000	120000	24000	344000	45000	$	575000
Cutbank	0	34	50	7	42000	95000	24000	136000	45000	$	342000
Dillon	1	18	30	7	42000	85000	24000	72000	45000	$	268000
Glasgow	0	43	50	7	42000	95000	24000	172000	45000	$	378000
Glendive	0	119	50	7	42000	95000	24000	476000	45000	$	682000
Great Falls	1	126	150	7	42000	145000	24000	504000	45000	$	760000
Havre	1	26	50	7	42000	95000	24000	104000	45000	$	310000
Helena	1	240	300	11	66000	220000	24000	960000	45000	$	1315000
Lewistown	1	34	50	7	42000	95000	24000	136000	45000	$	342000
Missoula	1	151	150	7	42000	145000	24000	604000	45000	$	860000
TOTALS					552000	1430000	288000	3968000	540000	$	6778000

Total System Cost For Former Tel Pak Points $ 4730500

EXHIBIT 30
Page 2 of 3

STATE of MONTANA

MICROWAVE TRANSMISSION SYSTEM
Digital Microwave
-Combined Transmission Method-
1997 System Quantities

RF Terminal Cost/Unit	$ 68600	Channel Equip/Circuit	$ 325
DC Pwr Supply Cost/Unit	$ 3000	RF Repeater Cost/System	$ 95000
Building Cost/Unit	$ 35000	Tower Cost/Ft	$ 400
Site Preparation Cost/Pt	$ 10000	Antenna System Cost/Ant	$ 4500
(DC Pwr Supply Base Cst	$ 14000)		

Site	Fmr Tel Pak ?	# Ckt Trm	Dst Mi	Elv Ft	Twr Hgt Ft	# RF Trm	Bldg 0/1	Pts Site Prep	RF Rpt 0/1	RF Equip	Ant	Tower	DC Power	Bldg	Site Prep	MUX Chns	Total
Miller Peak	1		13	7018	50	2	1	4	0	137200	9000	20000	20000	35000	40000	0	$ 261200
Hamilton	0	23	38	4100	30	1	0	1	0	68600	4500	12000	17000	0	10000	7475	$ 119575
Missoula	1	73	10	3227	40	1	0	1	0	68600	4500	16000	17000	0	10000	23725	$ 139825
Squaw Peak	1		36	7996	30	0	0	3	1	95000	0	12000	0	0	30000	0	$ 137000
White Clay Mt.	1		35	5680	30	2	1	4	0	137200	9000	12000	20000	35000	40000	0	$ 253200
Polson	1	15	31	3022	30	1	0	1	0	68600	4500	12000	17000	0	10000	4875	$ 116975
Blacktail Mt.	1		26	6757	30	0	1	2	1	95000	0	12000	0	35000	20000	0	$ 162000
Kalispell	1	35	16	3000	30	1	0	1	0	68600	4500	12000	17000	0	10000	11375	$ 123475
TOTALS										738800	36000	108000	108000	105000	170000	47450	$ 1313250

Total Route Cost For Former Tel Pak Points $ 1228675

PLAN TOTAL: $12,146,271

EXHIBIT 30
Page 3 of 3

COST SUMMARY

ALTERNATIVE TRANSMISSION METHODS

	Microwave Plant II			Fiber Optics	Satellite	Combined Methods	
		Digital					
	Analog	Low Density	Medium Density				
West	$ 3,683,200	$ 3,557,075	$ 3,826,175	$23,815,186	$9,400,500 Ground Segment +	Fiber	$ 4,055,021
East	3,851,600	3,996,175	4,347,175			Satellite - Ground Segment	6,778,000
North	4,057,400	4,552,800	4,938,900		2,016,000 Space Segment Lease	Microwave	1,313,250
Total	$11,592,200	$12,106,050	$13,112,250			Total	$12,146,271
						Satellite - Space Segment Lease	$ 2,016,000

NOTE: In addition to the above costs, estimated annual maintenance expenses of six percent of installed costs would be required.

EXHIBIT 31

STATE OF MONTANA

LIST OF DEPARTMENTS AND

LOCATIONS OF FIELD OFFICES

Agriculture

Plant and Industry Division - Commodity Services Bureau

Billings	Hamilton
Butte	Kalispell
Great Falls	Polson
	Sidney

Plant and Industry Division - Grain Standards Bureau

Great Falls

Wheat Research and Marketing Unit

Great Falls

Technical Services Bureau

Lewistown

Rodent Control Specialist

Lewistown

Pesticide Specialist

Missoula

Environmental Library

Missoula

Environmental Management Division

Billings	Great Falls
Bozeman	Lewistown
Glasgow	Missoula

Agricultural Experiment Station

(See MSU)	Havre
Conrad	Hobson
Corvallis	Huntley
Creston	Kalispell
Hamilton	Moccasin
Harrison	Sidney

Extension Service

Sidney

Health and Environmental Sciences

Billings

Air Quality Bureau
Food and Consumer Safety Bureau
Material and Child Health
Water Quality Bureau
Preventive Health Bureau

Butte

Occupational Health Bureau
Preventive Health Bureau

Glendive

Health and Environmental Services Dept.

Great Falls

Heart Disgnostic Center

Kalispell

Air Pollution Control
Air and Water Quality Bureau

Missoula

Preventive Health Bureau

Fish, Wildlife and Parks

Game Warden

Augusta	Crane	Havre	Seeley Lake
Baker	Deer Lodge	Lewistown	Shelby
Belgrade	Dillon (2)	Libby (2)	Sheridan
Big Timber	Ennis	Lincoln	Stanford
Broadus	Eureka	Livingston (2)	Stevensville
Butte (2)	Forsyth	Malta	Superior
Cascade	Fort Benton	Philipsburg	Thompson Falls
Chinook	Glendive	Plentywood	Townsend
Choteau	Hamilton	Polson	W. Yellowstone
Circle	Hardin	Red Lodge	Whitefish
Columbus	Harlowton	Roundup	White Sulphur Springs

Headquarters

Bozeman	Miles City - Office
Glasgow - Office	Missoula
Kalispell - Office	

Other

Madison Wall Creek Bunk House	- Ennis
Madison Wall Creek Game Range	- Ennis
Freezeout Lake Headquarters	- Fairfield
Bluewater Fish Hatchery	- Fromberg
Sun River Game Range	- Augusta
Fish Hatchery	- Big Timber
Wildlife Research Bureau	- Bozeman
Bitterrout Game Range	- Corvallis
Blackfoot-Clearwater Game Range	- Orvando
Fish Hatchery	- Great Falls
Judith Game Range	- Hobson
Fish Hatchery	- Lewistown
Fish Hatchery	- Libby
Wildlife Division	- Townsend
Game Farm	- Whitehall
Shop	- Whitehall
Lewis & Clark Caverns	- Ovando

Highways

Maintenance Shops

Alberton
Anaconda
Ashland
Augusta
Baker
Basin
Beaverslide
Belt
Big Sandy
Big Sky
Big Timber
Boulder
Boyes
Broadus
Browning
Busby
Cascade
Chester
Choteau
Circle
Columbia Falls
Conrad
Creeks Camp
Crystal Creek
Custer
Cut Bank
Deep Creek
Deer Lodge - (Garage)
Denton
Dillon - (Garage)
Divide
Drummond
Dupuyer
Dutton
Ennis
Fairfield
Fiddleback
Flowing Wells
Forsyth
Fort Benton
Glasgow
Grass Range
Hamilton
Harlem
Harlowton
Harrison - (Garage)
Hillside
Hot Springs
Hysham
Libby
Lima
Lincoln
Lodge Grass
Malta
Mobridge
Noxon
Nyack
Opheim
Philipsburg
Plains
Plentywood
Polson
Rainy Lake
Ravalli
Ronan
Roundup - (Garage)
Roy
Ryegate
Saint Mary
Saltest
Ingomar
Scobey
Seely Lake
Sidney
Stanford
Summit
Sunburst
Sun River
Superior
Terry
Thompson Falls
Three Forks - (Garage)
Townsend
Troy
Twin Bridges
Whitehall - (Garage)
White Sulphur Springs - (Garage)
Wibaux
Wilsall
Winnett
Wisdom - (Garage)
Wolf Creek

Division Offices

Billings
Bozeman
Butte
Glendive
Great Falls
Havre
Kalispell
Lewistown
Miles City
Missoula
Wolf Point

Weigh Stations

Bonner
Bozeman
Butte
Circle
Columbia Falls
Crow Agency
Crystal Creek
Drummond
Forsyth
Frenchtown
Great Falls (2)
Harlowtown
Kalispell
Libby
Lima
Lolo
Missoula
Seely Lake
Swan Lake
Wibaux

Section Houses

Duck Creek (W. Yellowstone)
Gallatin Gateway

Field Construction Office

Hobson

Institutions

Mental Health Center

Anaconda	Dillon	Great Falls	Ronan
Big Timber	Harlowton	Hamilton	Roundup
Chester	Lewistown	Hardin	Seely Lake
Chinook	Malta	Havre	Shelby
Choteau	Billings	Kalispell	Sidney
Columbus	Butte	Lincoln	Superior
Conrad	Forsyth	Miles City	Thompson Falls
Cut Bank	Glasgow	Missoula	Wolf Point
Denton	Glendive	Red Lodge	

Community Correction Bureau

Anaconda	Deer Lodge	Great Falls	Libby
Billings	Forsyth	Hamilton	Lincoln
Bozeman	Glasgow	Havre	Miles City
Butte	Glendive	Kalispell	Missoula
			Polson

Other

Boulder River School	- Boulder
Veterans' Home	- Columbia Falls
Board of Pardons	- Deer Lodge
Montana State Prison	- Deer Lodge
Financial Investigator	- Galen
Galen State Hospital	- Galen - See Warm Springs
Center for the Aged	- Lewistown
Pine Hills School	- Miles City
Youth Evaluation Program	- Great Falls
Swan River Youth Forest Camp	- Swan Lake
Warm Springs State Hospital	- Warm Springs
Women's Facility	- Warm Springs

Justice Department

Highway Patrol/Driver Exam

Billings	Butte	Kalispell	Missoula
Bozeman	Great Falls	Lewistown	

Board of Crime Control

Anaconda	Billings	Great Falls	Missoula

Fire Marshal Bureau

Billings	Chinook	Glendive	Missoula

Other

Law Enforcement Services Division - Law Enforcement Academy - Bozeman

Registrar's Bureau	- Deer Lodge
Forensic Sciences Division	- Missoula
Laboratory of Criminalistics	- Missoula

Labor and Industry

Job Service

Anaconda	Dillon	Kalispell	Polson
Billings (2)	Glasgow	Lewistown	Shelby
Bozeman	Glendive	Libby	Sidney
Browning	Great Falls	Livingston	Thompson Falls
Butte	Hamilton	Miles City	Wolf Point
Cut Bank	Havre	Missoula	

Other

Labor Standards Division - Apprenticeship Bureau/Standards Bureau/ Training/ Compliance Officer - Billings

Lands, State Department of

Forestry Division

Anaconda	Garrison	Kalispell	Missoula
Billings	Greenough	Lewistown	Plains
Bozeman	Hamilton	Libby	Swan Lake

Reclamation Division - Billings
Office - Glasgow

Military Affairs

Guard Companies

Anaconda	Deer Lodge	Harlowtown	Malta
Billings	Dillon	Havre	Miles City
Bozeman (2)	Glasgow	Kalispell	Missoula (3)
Butte	Great Falls	Lewistown	Plentywood
Chinook	Glendive	Libby	Shelby
Culbertson	Hamilton	Livingston	Sidney
			Whitefish

Organizational Maintenance Shop

Belgrade	Chinook	Kalispell	Missoula
Billings	Culbertson		

Reserve

Billings	Glendive	Great Falls	Missoula
Bozeman			

Natural Resources

Tongue River Dam - Birney - Ashland
Oil & Gas Conservation District - Sidney, Billings, Glendive, Shelby
Water Rights Bureau - Billings Havre Missoula
Bozeman Lewistown
Glasgow Miles City
Daly Ditches Projects - Hamilton
Weather Notification - Miles City

Revenue

County Appraiser
County Assessor

Anaconda	Cut Bank	Jordan	Shelby
Baker	Deer Lodge	Kalispell	Sidney
Big Timber	Dillon	Lewistown	Stanford
Billings	Ekalaka	Libby	Superior
Boulder	Forsyth	Livingston	Terry
Bozeman	Fort Benton	Malta	Thompson Falls
Broadus	Glasgow	Miles City	Townsend
Butte	Glendive	Missoula	Virginia City
Chester	Great Falls	Plentywood	Warm Springs
Chinook	Hamilton	Polson	Wibaux
Choteau	Hardin	Red Lodge	Winnet
Circle	Harlowton	Roundup	Wolf Point
Columbus	Havre	Ryegate	Helena
Conrad	Hysham	Scobey	Phillipsburg

State Liquor Stores

Anaconda	Cut Bank	Harlowtown	Ronan
Ashland	Deer Lodge	Havre	St. Ignatius
Baker	Dillon	Kalispell (2)	Scobey
Belgrade	Drummond	Laurel	Shelby
Big Fork	Ennis	Lewistown	Sheridan
Big Timber	Eureka	Libby	Sidney
Billings (4)	Forsyth	Lincoln	Thompson Falls
Bozeman (2)	Fort Benton	Livingston	Three Forks
Browning	Frenchtown	Malta	Townsend
Butte (2)	Gardiner	Miles City	Troy
Chester	Glasgow	Missoula (2)	Victor
Choteau	Glendive	Philipsburg	Walkerville
Colstrip	Great Falls (3)	Plentywood	W. Yellowstone
Columbia Falls	Hamilton	Polson	Whitefish
Columbus	Hardin	Poplar	Whitehall
Conrad	Harlem	Red Lodge	Warm Springs
			Wolf Point

Child Support Enforcement Bureau

Billings	Butte	Great Falls	Missoula

Income Tax Division

	Billings	Missoula	

Investigation Division

Billings	Glasgow	Miles City	Missoula
Butte	Great Falls		

Social and Rehabilitation Services

Offices

Billings	Crow Agency	Havre	Miles City
Boulder	Deer Lodge	Kalispell	Missoula
Bozeman	Glasgow	Lame Deer	Poplar
Browning	Glendive	Lewistown	Shelby
Butte	Great Falls	Livingston	Wolf Point
			Warm Springs

University System

Agricultural Experiment Station - (MSU) Bozeman
Montana Tech - Butte
Cooperative Extension Service - Bozeman
Eastern Montana College - Billings
Montana State University - Bozeman
Northern Montana College - Havre
University of Montana - Missoula
Western Montana College - Dillon

Miscellaneous

District Judges - Billings
Economic Opportunity - Billings, Great Falls, Missoula
Roundup
Horticulture Inspection & Quarantine Service - Butte
Montana Drug Program - Butte
Montana Bureau of Mines and Geology - Butte
Vocational Technical Center - Butte, Great Falls
Commerce Department
Board of Pharmacists - Great Falls
Board of Public Education
School for the Deaf and Blind - Great Falls
Fire Services Training School - Great Falls
Flathead Valley Community College - Kalispell
Board of Education - Montana Historical Society - Libby
Governor's Office - Legal Jurisdiction Project - Missoula